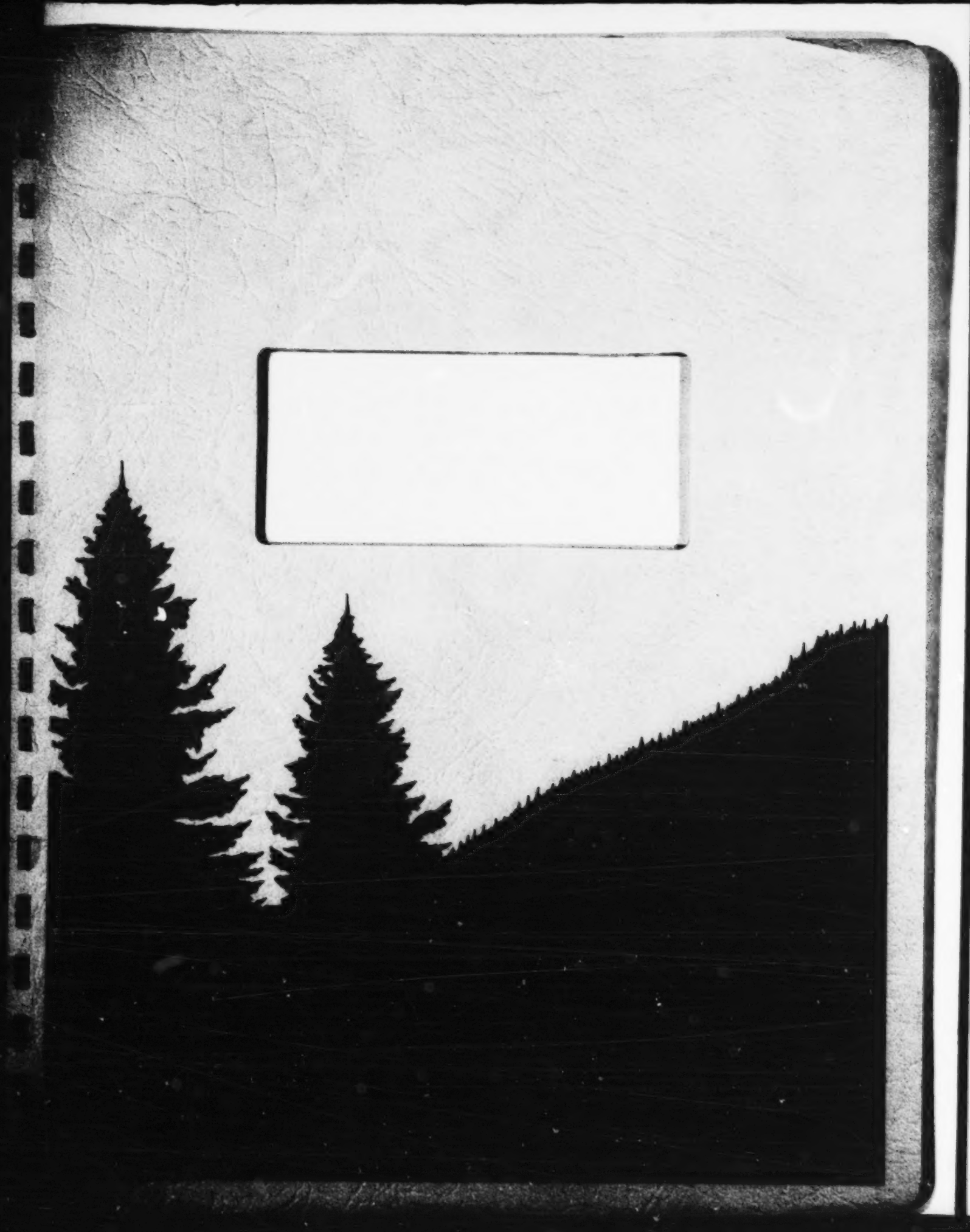


PRINCE GEORGE TSA

OPTIONS REPORT

Prince George Forest Region
Ministry of Forests

March 1986

TABLE OF CONTENTS

		Page
	Table of Contents	i
	List of Figures	ii
	List of Tables	iii
1.0	INTRODUCTION	1
2.0	EXECUTIVE SUMMARY	3
3.0	DESCRIPTION OF THE PRINCE GEORGE TSA	5
4.0	ANALYSIS RESULTS	11
	4.1 OPTION I : Continue Current Management (Status Quo)	12
	4.2 OPTION II: Reduce Timber Supply Falldown	19
	4.21 Improve Utilization of Coniferous Forest Types	20
	4.22 Increase Silviculture Program Funding	23
	4.23 Increase Protection Program Funding	26
	4.24 Upgrade the B.C. Rail Dease Lake Extension	28
	4.3 OPTION III: Increase the Current Rate of Harvest	30
	4.31 Improve Utilization of Coniferous Forest Types	31
	4.32 Upgrade the B.C. Rail Dease Lake Extension	33
	4.33 Increase Protection Program Funding	35
5.0	SUMMARY AND COMPARISON OF OPTIONS	37
6.0	DISCUSSION OF MANAGEMENT ISSUES	39
7.0	APPENDICES	41
	7.1 Summary Tables	41
	7.2 Analysis Methodology	43
	7.3 Uncertainty in Data Assumptions, Modelling Procedures and Analysis Results	45
	7.4 Glossary	51
	7.5 References	55

LIST OF FIGURES

Figure		Page
1.	Prince George TSA - Key Map for Province/TSA/Region	6
2.	Prince George TSA - Key Map for TSA/Districts	7
3.	Prince George TSA - Key Map for TSA/Supply Blocks	8
4.	Inventory Classification of the Total TSA Area	9
5.	Map showing Supply Blocks A and B1 Exclusion	12
6.	Inventory Classification of the Total TSA Area Excluding the Sustut and North Takla Supply Blocks	13
7.	Age Class Distribution for Scenario A	15
8.	Harvest Forecast for Scenario A	16
9.	Trends in Age Class Distribution for Scenario A	17
10.	Projected Trend in Average Stand Volume Harvested	18
11.	Projected Trend in Average Stand Diameter Harvested	18
12.	Harvest Forecasts for Scenarios B and C	21
13.	Harvest Forecast for Scenario D	24
14.	Forecasted Trends in NSR and NCC Area	25
15.	Harvest Forecast for Scenario E	27
16.	Harvest Forecast for Scenario F	28
17.	Harvest Forecast for Scenario G	32
18.	Harvest Forecast for Scenario H	34
19.	Harvest Forecast for Scenario I	36

LIST OF TABLES

Table		Page
1.	Implementation Requirements for the 20 Year TSA Plan	4
2.	Prince George TSA Resources	10
3.	Status Quo Management Assumptions	14
4.	Silviculture Program Assumptions	23
5.	Current Scheduled Harvest in Comparison to LRSY	29
6.	Scheduled Operations in the Takla/Sustut Supply Blocks	33
7.	Summary and Comparison of Options	38
8.	Area Classification and Net Land Base Summary	41
9.	Protection Program: Unsalvaged Losses	42
10.	Comparison of the Inventory and Planning Methodology Changes	46
11.	Comparison of the "1980" and "1985" AAC Rationale Option	47

1.0 INTRODUCTION

The purpose of this report is to present the integrated resource use options which have been selected by the Ministry of Forests for consideration in the development of a management plan for the Prince George Timber Supply Area (TSA). This report includes a description of the timber supply analyses which have been carried out to support the development and selection of these options. This report has been prepared by Prince George Forest Region Planning Section, in consultation with the Resource Planning Section of the Planning and Inventory Branch.

The timber supply analyses which are documented, compared and interpreted in this report were carried out over a two year period from 1984 to 1986. These analyses examine options which have been drawn from the options identified in the Statement of Issues, Options and Procedures (March 1984). Further information regarding the development of the options in this report may be found in the Prince George TSA Data Package (August 1984). In addition, these analyses build upon numerous preliminary studies (see References) and estimates of timber availability (Estimating Timber Availability using Multiresource Cut/Leave Ratios: A working paper in support of the Prince George TSA Plan, November 1983). These preliminary studies and timber availability assessments examined timber licensee operating areas which resulted in the determination of 20 year supplies of Crown timber as set forth in the Prince George TSA 20 year Operating Area Plan.

The development of a TSA plan for the Prince George TSA was initiated prior to the development of the current TSA planning process as set out in Chapter 3 of the Resource Planning Manual. The steps which have been followed, therefore, have differed from the current TSA planning process in the following respects:

1) Considerations for range, recreation and other resource uses have been made through the above preliminary studies and timber availability assessments, rather than through Range, Recreation and Other Resources Information and Analysis Reports as described in Chapter 3 of the Resource Planning Manual;

2) The Prince George TSA Data Package (August 1984) serves as the Timber Supply Analysis Information Report;

3) The Timber Supply Analysis Report and the TSA Options Report have been combined into this single report; and

4) Timber licensee operating areas have been delineated in terms of 20-year supplies of Crown timber on the basis of the above timber availability assessment and prior to the development and selection of the options presented in this report.

This report contains an Executive Summary (Section 2.0), and a brief description of the Prince George TSA (Section 3.0). It also describes, the timber supply analysis results for each option (Section 4.0), and summarizes and compares these options (Section 5.0). And lastly, this report contains a discussion of the major management issues (Section 6.0) and provides (Section 7.0) numerous summary tables, a description of analysis methodology, a discussion of uncertainty in data assumptions, modelling procedures and

analysis results, a glossary of technical planning terminology and a list of references.

This report, and written comments and recommendations on it, will provide a basis for the Regional Manager's recommendation of a TSA planning option to the Chief Forester. Along with the already chosen timber licensee operating areas, this report, with comments, will guide the preparation of a TSA plan for the Prince George TSA. The TSA plan will set out the production targets for the timber, range and recreation resources under MoF jurisdiction, establish the management strategies for their achievement and identify the Five Year Program required for their implementation. The TSA plan will include the Allowable Annual Cut (AAC) for timber. The AAC is the first five years of the timber harvesting production target as set out in the TSA plan.

Written comments and recommendations regarding the options presented in this report should be forwarded no later than April 4, 1986, to:

Regional Manager
Prince George Forest Region
1011 - Fourth Avenue
Prince George, British Columbia
V2L 3H9

Attention: Regional Planning Officer

2.0 EXECUTIVE SUMMARY

This timber supply analysis presents an updated projection of the timber supply situation in the Prince George TSA, which differs from that presented in 1979 and updated for the 1984 Resource Analysis. This current analysis is based on an improved inventory data base for planning purposes and more realistically presents the implications of continuing the past five years management into the future or changing these management practices over time.

Option I, presents a projection of the allowable rate of harvest assuming the continuation of historical management practices and program funding levels into the future. If this historical performance continues, then future harvest levels will fall to approximately 72% of their current levels, starting in 50 years.

Option II, presents alternative projections of the allowable rate of harvest assuming that changes are made to the current level of forest management and current harvest levels remain the same. These changes include improving the utilization of coniferous forest types, increasing silviculture and protection program funding levels and accessing presently unavailable areas. If these changes are made to the status quo level of forest management, then current harvest levels may be continued past 70 years, and will then fall, depending on the management alternative to within 79% to 95% of their current levels.

Option III, presents alternative projections of the allowable rate of harvest, with the assumption that the current AAC can be temporarily increased for the next 10 years, if various strategies can be implemented. These strategies are aimed at extending the onset or reducing the magnitude of the projected fall-down, by improving balsam problem forest type utilization; by restoring services on the BC Rail Dease Lake Extension; and by increasing the Forest Service Reserve (an apportionment of the approved AAC) to ensure improved salvage operations associated with current pest detection, assessment and control efforts. Collectively, all scenarios in this option would suggest an increase in the AAC of 1 150 000 m^3, from 8 605 000 m^3, to 9 755 000 m^3 for the next 10 years only. After this period, and if the above strategies can be implemented, the current AAC may be continued past 80 years before falling, depending on the management alternative, to within 80% to 87% of the current AAC. The annual monitoring of these strategies would be used a a firm basis for adjustment to future timber supply analyses and TSA Plan updates.

Implementation of TSA plan based on Option I or Scenarios B and C of Option II require no increases to present Five Year Program goals. For Option II, Scenarios D, E, F and all scenarios in Option III, implementation of a TSA Plan based on these scenarios would require substantial increases to current Five Year Program goals. The extent to which these goals are achieved will be based on government funding.

A synthesis of the analysis results, expressed as alternative management directions is shown in Table 1. These alternatives reflect the harvesting and program requirements that must be implemented over the next 20 years to harvest the annual allowable cut, restock denuded areas, and protect and improve the productivity of the growing stock. In future TSA plan reviews

which are done approximately every 5 years, these analyses will be reviewed, and adjusted as required.

Table 1. Implementation Requirements for the 20 Year TSA Plan

Management Option	Scenario	AAC (m^3)	Harvesting Requirements		Program Requirements		Implication on Timber Supply in the Long Term
			Merchantability	Dease Lake Extension	Silviculture	Protection	
I	A	8 605 000	Historical performance over last 5 years	Not operational	$ 10,161,000	$ 309,000	28% falldown of timber supply starting in 50 years
II	B	8 605 000	Short term utilization of Problem Forest Types	Same as A	Same as A	Same as A	5%-21% falldown in Timber Supply starting in 70-200+ years
	C	8 605 000	Long term utilization of Problem Forest Types	Same as A	Same as A	Same as A	
	D	8 605 000	Same as B	Same as A	$ 13,431,000	Same as A	
	E	8 605 000	Same as B	Same as A	$ 13,431,000	$ 959,000	
	F	8 605 000	Same as B	Operational	$ 13,431,000	Same as A	
III	G	8 755 000	Same as B but Utilization of Balsam Problem Forest Types	Same as A	$ 10,380,000	Same as A	13-20% falldown in Timber Supply starting in 80-90 years
	H	9 585 000	Same as B	Operational	$ 14,379,000	Same as A	
	I	8 705 000	Same as B	Same as A	$ 13,431,000	$ 959,000	

3.0 DESCRIPTION OF THE PRINCE GEORGE TSA

The Prince George TSA is one of five TSAs in the Prince George Forest Region. It is located in the north-central interior of British Columbia (Figure 1) and is administered by the Prince George East, Prince George West, Fort St. James and Vanderhoof Forest Districts (Figure 2). The TSA is further subdivided into 9 Supply Blocks on the basis of existing milling centres and overall timber characteristics (Figure 3). With a Productive Crown Forest Area of 5 310 000 ha and an AAC of 8 605 000 m^3, it is the single largest management unit in the Province. An inventory classification of the Total TSA Area is shown in Figure 4.

The TSA includes the city of Prince George and the communities of Vanderhoof, Fort St. James, Hixon, Fraser Lake, Fort Fraser, Strathnaver, Giscome, Upper Fraser and Bear Lake. With 27 major sawmills, 3 pulpmills and numerous smaller mills, the economy of the TSA is dominated by milling and logging activities.

The AAC apportionment, authorized level of forage harvesting, and the supply and demand of Forest Service Recreation facilities for the Prince George TSA are shown in Table 2. The Prince George TSA currently supports an AAC of 8 605 000 m^3 in timber, 70,000 Animal Unit Months of Crown range capacity and 147,000 user visits (1984) on Forest Service campsites and trails.

Figure 1. Prince George TSA - Key Map for Province/Region/TSA

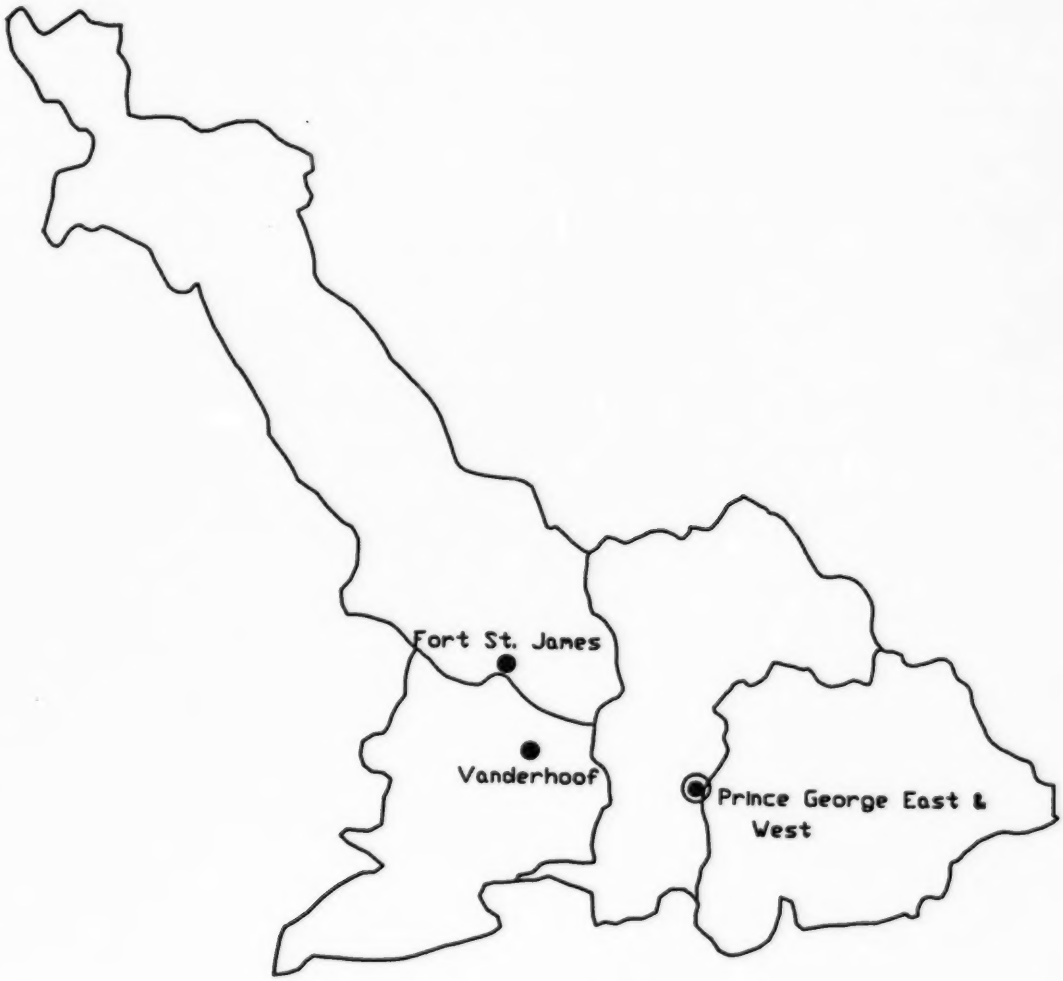


Figure 2. Prince George TSA - Key Map for TSA/Districts

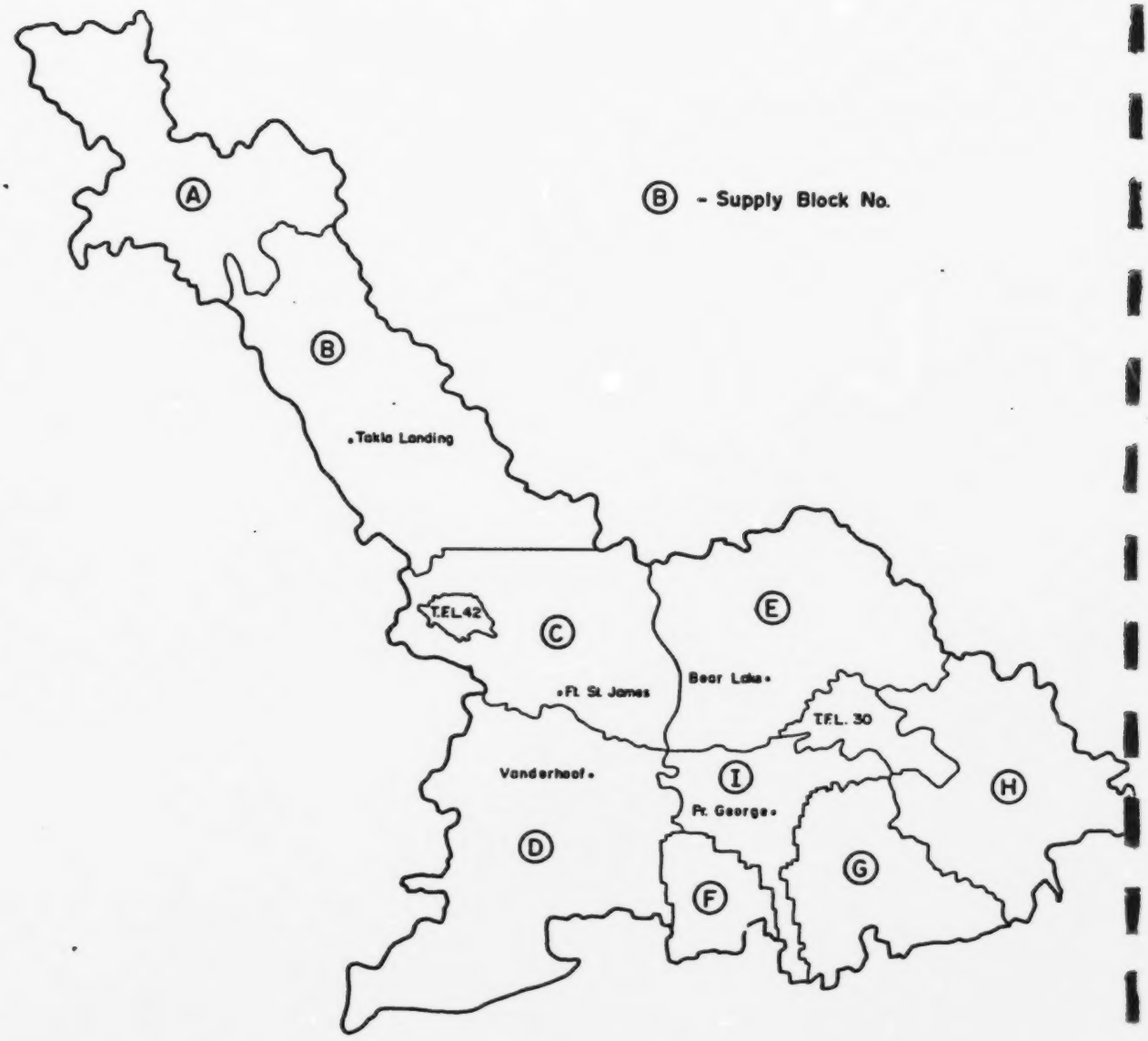
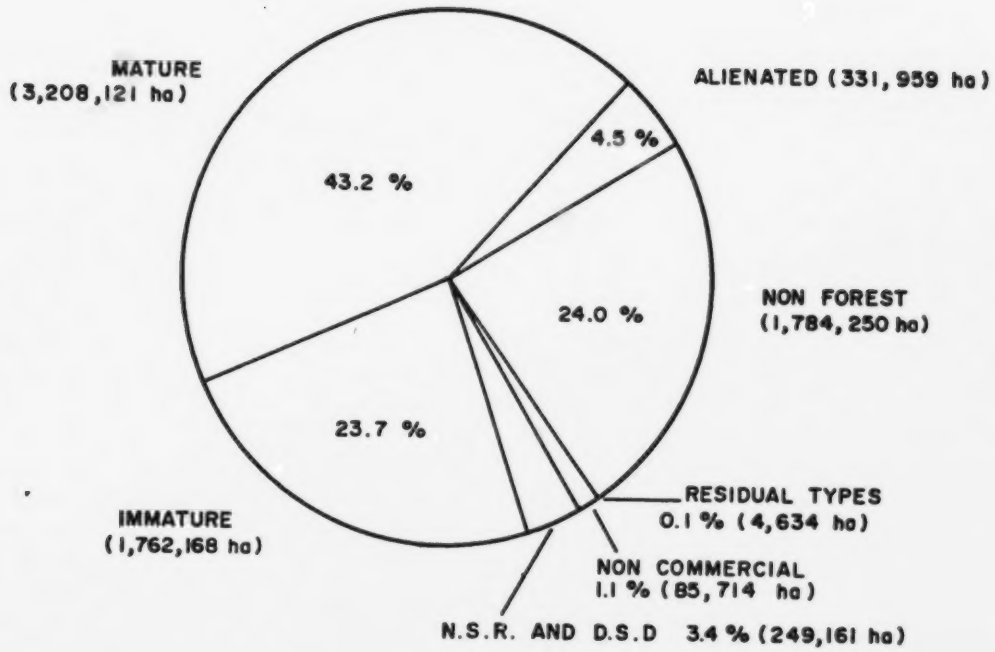


Figure 3. Prince George TSA - Key Map for TSA/Supply Blocks



TOTAL TSA AREA 7,426,007 ha

Figure 4. Inventory Classification of the Total TSA Area

Table 2: Prince George TSA Resources

AAC Apportionment:		
Approved AAC	8 605 000 m^3	or 100.0%
Forest Licences	7 184 690 m^3	or 83.5%
Timber Sale Licences		
Designated Applicants	211 430 m^3	or 2.5%
Timber Sale Licences		
SBEP - Category 1	887 400 m^3	or 10.3%
SBEP - Category 2	156 600 m^3	or 1.8%
Woodlot Licences	87 000 m^3	or 1.0%
Forest Service Reserve	77 880 m^3	or 0.9%
Authorized Forage Harvesting:		
Total Rated Capacity	70,000 AUM	or 100%
Community Pastures	15,000 AUM	or 21%
Crown Range Outside CP's		
Grazing Licences	6,000 AUM	or 9%
Grazing Permits	49,000 AUM	or 70%
Forest Service Recreation Facilities:		
Total Estimated User Visits	147,000 (1984)	
Total Campsites	139 (45% of demand)	
Trails	190 km (40% of demand)	

4.0 ANALYSIS RESULTS

The Statement of Issues, Options and Procedures (March 1984) outlined several options and scenarios to be examined as a basis for the development of a TSA Plan for the Prince George TSA. For ease of reporting and interpretation, those options have been renamed and renumbered to the following:

Option I Continue Current Management;

Option II Reduce Timber Supply Falldown; and

Option III Increase the Current Rate of Harvest.

The above options have been further divided into a number of scenarios each of which represents different combinations of assumptions within the broader set of assumptions which distinguish the three options. This section, therefore, presents the timber supply analysis results for Scenario A (Option I), Scenarios B-F (Option II), and Scenarios G-I (Option III).

Option I, the option to continue current management performance, examines the timber supplies which can be expected if current management practices and program levels are to be continued. This option includes the constraint that the rate of harvest will not increase above the current AAC of 8 605 000 m^3. The results show the timing and magnitude of the projected falldown.

Option II, the option to reduce timber supply falldowns by changing various management practices, examines the extent to which these practices can extend the onset or reduce the magnitude of the falldown presented in Option I. This option, also constrains the rate of harvest to the current AAC of 8 605 000 m^3.

Option III, the option to increase the rate of harvest, examines similar, though not identical, management practices as those examined in Option II. However, rather than examine the extent to which these management practices reduce the timber supply falldown, these practices are examined to assess increases in the current rate of harvest. A short term increase in the AAC is evaluated as part of a long term strategy to extend the onset or reduce the magnitude of the falldown presented in Option I.

Another important consideration in interpreting these options relates to the timber supply objectives which are assumed. The analyses in this report use the IFSYIELD forest planning model and the use of this model is structured to reflect the following timber supply objectives for the TSA:

- maintenance (or enhancement), if possible, of the current AAC in the first decade;
- a maximum permissible reduction in harvest level of 10% per decade;
- a regulated forest at the end of the planning horizon; and
- subject to the above, maximization of total volume yield over a 200 year planning horizon.

4.1 Option I: Continue Current Management (Status Quo)

This option, assumes the continuation of current management practices. Current management practices are defined as historical performance over the immediately preceding five year period.

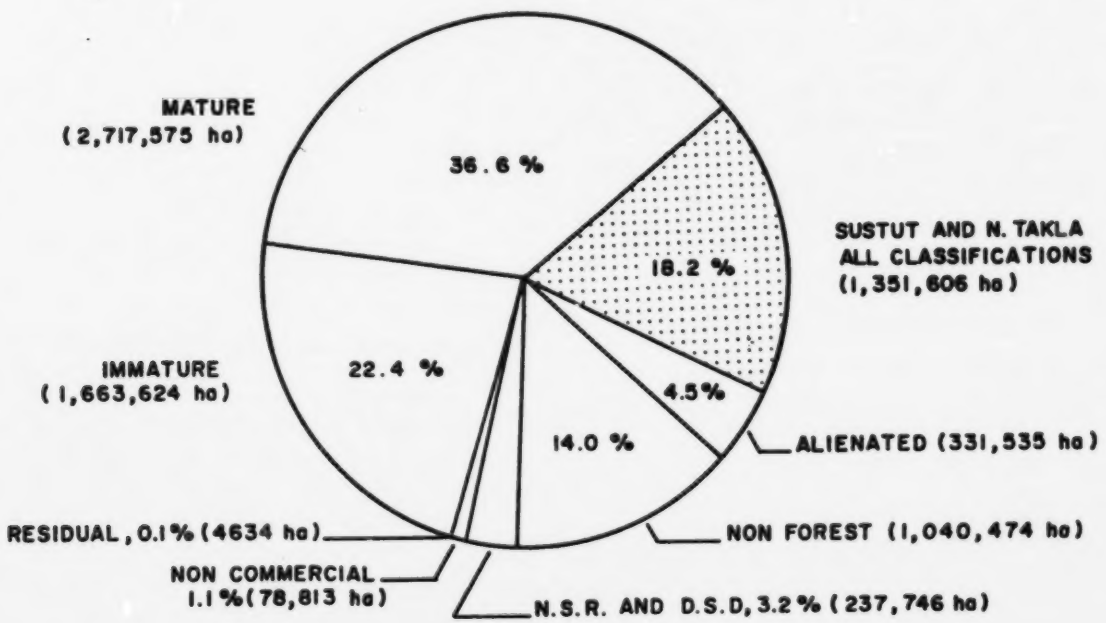
Several key issues are involved in assessing "current" management practices. The first issue is the status of the B.C. Rail Dease Lake Extension. At the time of the last timber supply analysis (1979) this section of rail line, providing the only economic means of transporting logs from the Sustut Supply Block (A) and the northern third of the North Takla Supply Block (B), was in operation. Thus, it was assumed in the rationale for the 1980 AAC that the rail line would continue in operation.

However, deterioration of the roadbed and the attendant escalation in maintenance costs (coupled with reduced traffic) led to closure of the line in 1981. The Status Quo Option therefore excludes that portion of the TSA land base now deemed inaccessible due to lack of rail access and further, where alternative road access is judged economically infeasible for the foreseeable future (Figure 5).

Figure 5. Map showing Supply Blocks A and B1 Exclusion

Figure 6 illustrates the total TSA area with the exclusion of Supply Block A and B-1 as per Figure 5.

The Sustut and North Takla Supply Blocks contain approximately 18% of the Total TSA area. Excluding these supply blocks from the Productive Crown Forest Area (all forested land in the TSA) results in an 11% smaller area. Excluding those supply blocks from the Net Land Base results in a 7% smaller area. See Table 8 in Appendix 7.1 for further details.



TOTAL TSA AREA 7,426,007 ha

Figure 6. Inventory Classification of the Total TSA Area by Excluding the Sustut and North Takla Supply Blocks

A second key issue in assessing current management practices, is the issue of utilization standards. The rationale for the 1980 AAC assumed close utilization less decay, waste and breakage of all species to a 17.5 cm dbh limit. In 1983, the mandatory diameter limit was lowered to 12.5 cm dbh for lodgepole pine in all supply blocks and to 15.0 cm dbh in Supply Blocks D, F and I for white spruce, balsam and Douglas-fir. It remains at 17.5 cm dbh for these species in the remaining supply blocks. This option therefore assumes the new utilization standard as "current" management practice.

A third key issue is the level of both basic and intensive silviculture activities. The rationale for the 1980 AAC assumed that basic silviculture would be achieved and that no intensive silviculture activities would be carried out. However, current practices is such that basic silviculture is not being achieved and significant intensive work is being funded.

This option therefore assumes a level of activity commensurate with the basic and intensive silviculture programs funded as per the 1984/85 fiscal year. Option II, Scenario D (Section 4.22) examines the effect of achieving basic silviculture coupled with improved intensive silviculture as a result of the joint Federal/Provincial Forest Resource Development Agreement (FRDA).

The remaining assessment of current management practices with respect to the merchantability and definition of problem forest types, minimum operable volumes per hectare and the silvicultural regimes assumed in the program are documented in detail in the Prince George TSA Data Package (August 1984).

This option (Scenario A) addresses the three issues discussed above and is summarized in Table 3.

Table 3: Status Quo Management Assumptions

Land Base:	Supply Blocks A and B1 excluded(1)
Utilization Standards:	Lodgepole Pine - 12.5 cm+, all Supply Blocks
	Other Coniferous - 15.0 cm+, Supply Blocks D, F and I - 17.5 cm+ remaining Supply Blocks
Problem Forest Type Utilization:	Current since 1979 (79/84)
Basic Silviculture Funding:	$ 7,844,000(2)
Intensive Silviculture Funding:	$ 2,316,000(3)
Protection Funding:	$ 309,000

Notes:

(1) See Figure 5.

(2) Actual 84/85 basic budget is $6,808,000. Total shown includes $1,036,000 of unbudgeted but instructed prescribed burning, on 5 200 ha. See Table 4 for further details.

(3) See Table 4 for further details.

After excluding Supply Blocks A and B1, all low sites, deciduous types, all non-forested lands (NSR, NC, DSD) portions of Environmentally Sensitive Areas (ESAs) and coniferous problem forest types, the current Net Land Base is 2 379 600 hectares.

There are approximately 7 400 hectares of Timber Licences which when harvested and restocked will contribute to the TSA timber supply. Additionally, approximately 247 900 hectares of NSR, DSD, and NCC lands are either stocked (93 500 hectares) or will become stocked (154 400 hectares) in accordance with the current (1984/85) intensive silviculture program over the next 40 years. These additions will raise the Net Land Base to 2 634 900 hectares. Appendix 7.1 contains a complete area classification for each scenario. Figure 7 illustrates the age class distribution of area by species.

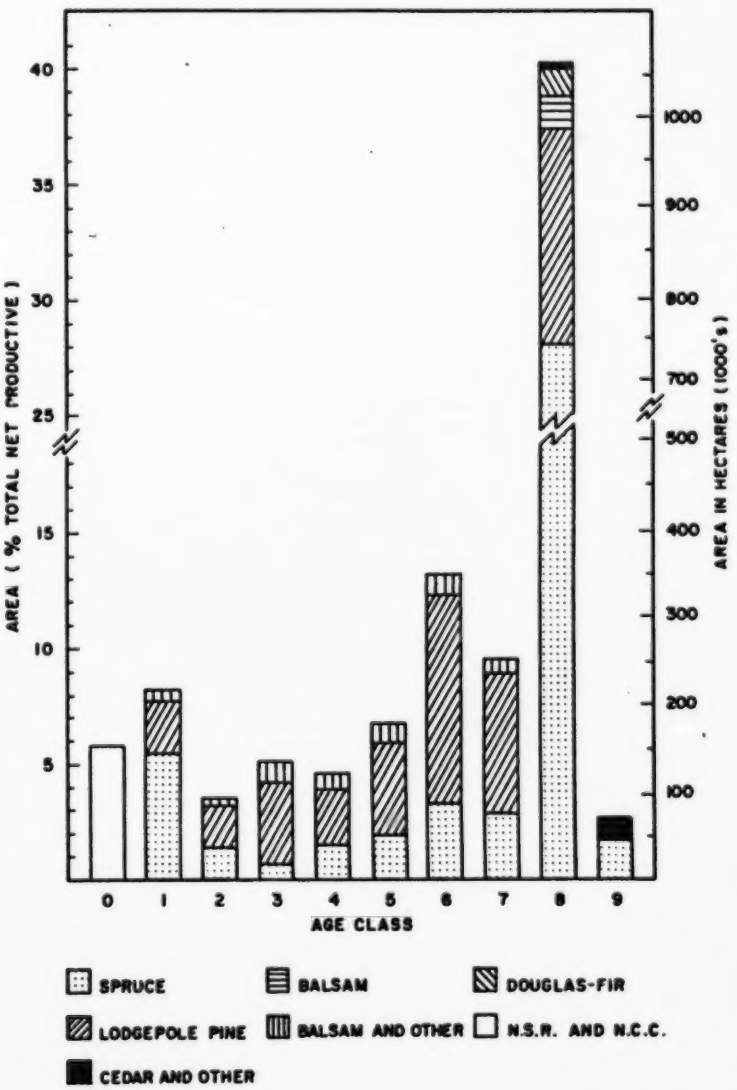


Figure 7. Age Class Distribution for Scenario A

The timber supply objective of maintaining the AAC for as long as possible (subject to the maximum 10% per decade falldown guideline) is depicted in Figure 8[1]. As shown, current management practices and funding will maintain the AAC for 50 years before rates of harvest fall to the Long Run Sustained Yield (LRSY) of 6 237 000 by year 90.

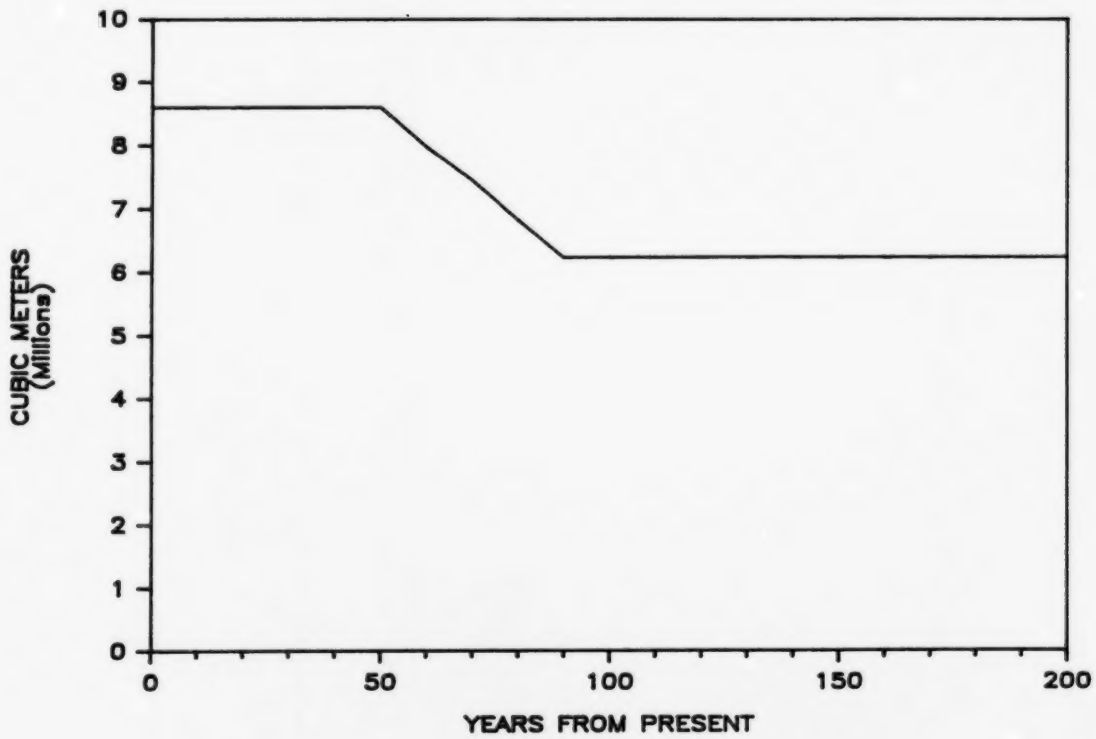


Figure 8. Harvest Forecast for Scenario A

---

1 In this report, harvest forecasts are shown excluding unsalvaged losses to insects, fire and windthrow. See Appendix 7.1 for a detailed summary of current and projected unsalvaged losses. The volumes in Table 9 must be added to the volumes reported in the harvest forecasts to arrive at the total harvested volume used in the IFSYIELD forest planning model.

It should be noted that all harvest forecasts in this report, are based on harvesting priorities in the IFSYIELD forest planning model which considers the following:

1) A minimum harvesting age that is based on stand culmination age or that age which provides the required minimum volume per hectare, whichever age is greater;

2) A maximum harvesting age that ensures that older aged timber is harvested before it reaches decadence (applied for 80 years); and

3) A harvesting rule which selects those stands with the highest mean annual increment (MAI) within the minimum and maximum harvesting ages.

The consequences of this harvesting priority on the growing stock of the TSA is forecasted in terms of distribution of area by age class (Figure 9).

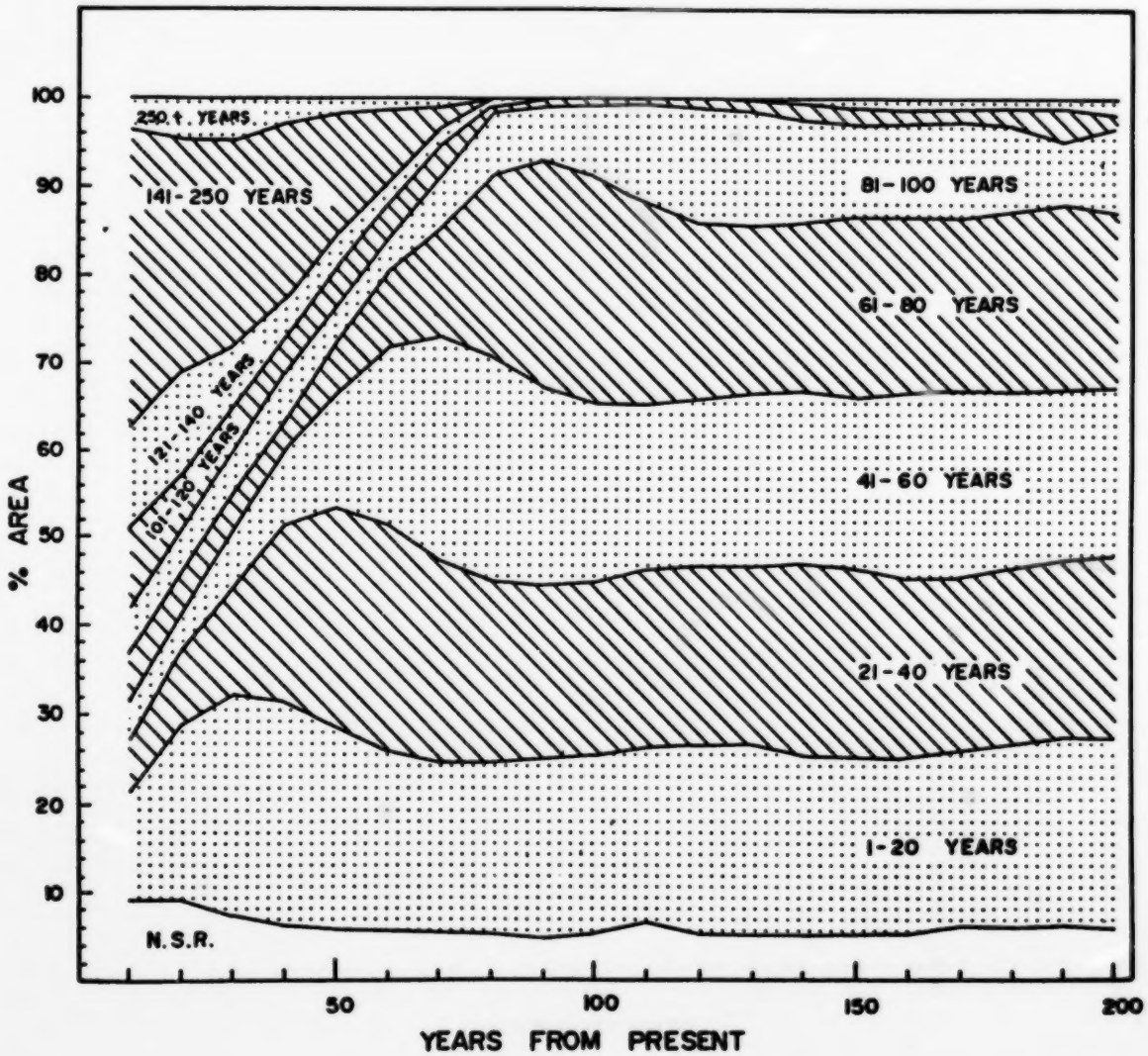


Figure 9. Trends in Age Class Distribution for Scenario A

The harvesting priorities in the IFSYIELD forest planning model also lead to a rise in volume from a current average of 313 m^3 per ha to a high of 349 m^3 per ha in year 50. This is attributable to concentrated harvesting in old growth spruce and pine stands. Figure 10 forecasts the average volume per hectare harvested.

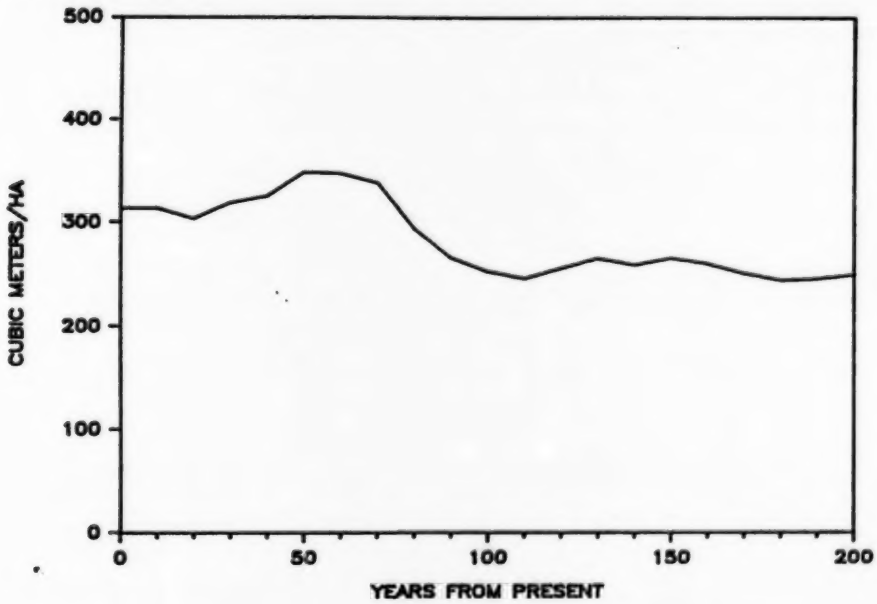


Figure 10. Projected Trend in Average Stand Volume Harvested

Similarly, Figure 11 forecasts the average stand diameter harvested, which falls over the planning horizon from an average of 36.0 cm to a long-term average of 25.0 cm. This is attributable to increasing harvest of younger aged stands.

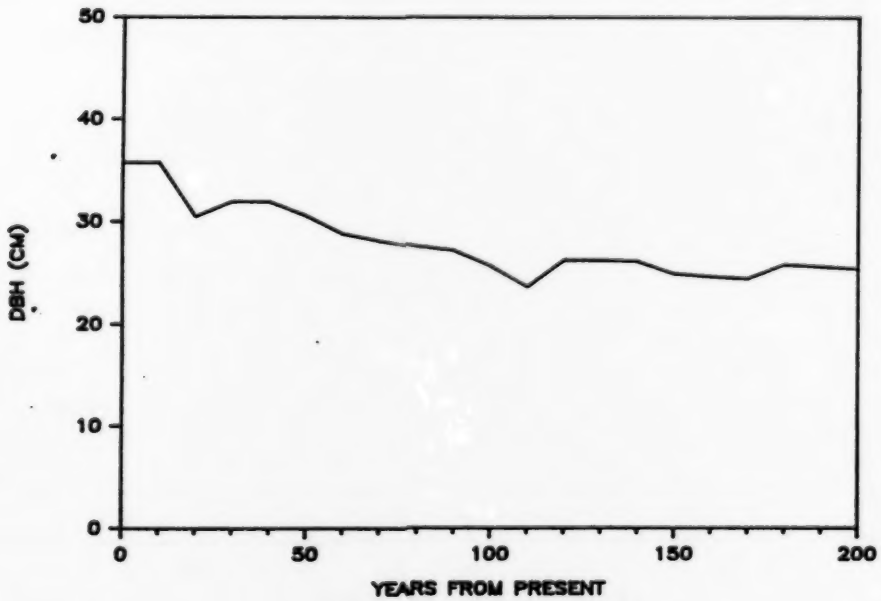


Figure 11. Projected Trend in Average Stand Diameter Harvested

4.2 Option II: Reduce Timber Supply Falldown

This option assesses the impact on future harvest rates of changing the present level of forest management but constraining the current rate of harvest to the present AAC. Opportunities exist to extend the time until falldown through several forest management opportunities which include:

- improved utilization of coniferous forest types - Scenarios B and C, Section 4.21;
- increased silviculture 5 Year Program funding - Scenario D, Section 4.22;
- increased protection 5 Year Program funding - Scenario E, Section 4.23; and
- upgrading the B.C. Rail Dease Lake extension - Scenario F, Section 4.24.

The above opportunities cannot be implemented without increases in capital and operating costs. In this analysis, the concern is more with testing broad strategies rather than detailing tactical considerations involving specific financial, manpower and other resource requirements associated with their implementation.

As in Option I, the timber supply objective in this option is to maintain the present AAC for as long as possible until such time that the inventory will not support the current AAC. This policy assumes that the above management practices will not increase the present AAC but the benefits from these practices will accrue to the harvest rate in the future, by extending the period to falldown and/or increasing the LRSY.

4.21 Improved Utilization of Coniferous Forest Types

The following scenarios assess the potential of coniferous problem forest types to alleviate the forecasted deficits which are presented in Option I (Scenario A).

The analysis assumptions which these alternatives (Scenarios B and C) are based on are as follows:

(1) Assume the B.C. Rail Dease Lake Extension is not operational, and therefore Supply Blocks A and B1 (per Figure 5) remain excluded from the Net Land Base;

(2) Assume Status Quo silviculture and protection program funding; that is, the addition of problem forest types is to be the only management change from Option I; and

(3) Use both a 20 year (term of the TSA Plan) and a 100 year look-ahead period in reviewing problem forest types for inclusion.

Problem forest type is a commonly used term which could be more explicitly defined as a "marginal timber type" in an economic sense, and as used in this report. Some marginal timber types are included in the status quo Net Land Base (Scenario A), more are included in the 20 Year Net Land Base (Scenario B), and even more are included in the 100 Year Net Land Base (Scenario C).

Coniferous problem forest types are usually mature timber stands defined by the following inventory descriptions:

(1) Any timber stand which is Height Class 2 (10.4-19.4 meters in height), all species;

(2) Any white spruce, balsam or Douglas-fir stand which is Stocking Class 2 (fewer than 76 trees per hectare) and any lodgepole pine stand which is Stocking Class 2, 3 or 4 (understocked or overstocked stands); and

(3) Any leading cedar, hemlock and in some cases pure balsam stands, all height and stocking classes.

Two scenarios were developed to assess the potential of coniferous problem forest type utilization. Scenario B includes those additional problem forest types which are likely to become merchantable during the next 20 years and hence will contribute to the Net Land Base of the TSA Plan. Scenario C includes those additional problem forest types which may become merchantable in the long term (100 years plus). Scenario C is therefore, a crystal ball look into the future, to assess the full potential of coniferous problem forest type utilization.

The review of problem forest types for Scenario B (20-year merchantability look-ahead) resulted in the addition of 242 600 ha to the Net Land Base, bringing the total to 2 877 500 ha (see Appendix 7.1).

The timber supply objective for Scenario B of maintaining the current AAC of 8 605 000 m^3 for as long as possible is presented in Figure 12. For

comparison, the harvest forecast for the Option I (Scenario A) has also been presented. As illustrated, the period to the commencement of falldown is extended by 20 years to year 70, before falling to the LRSY of 6 768 000 m^3 per year by year 100.

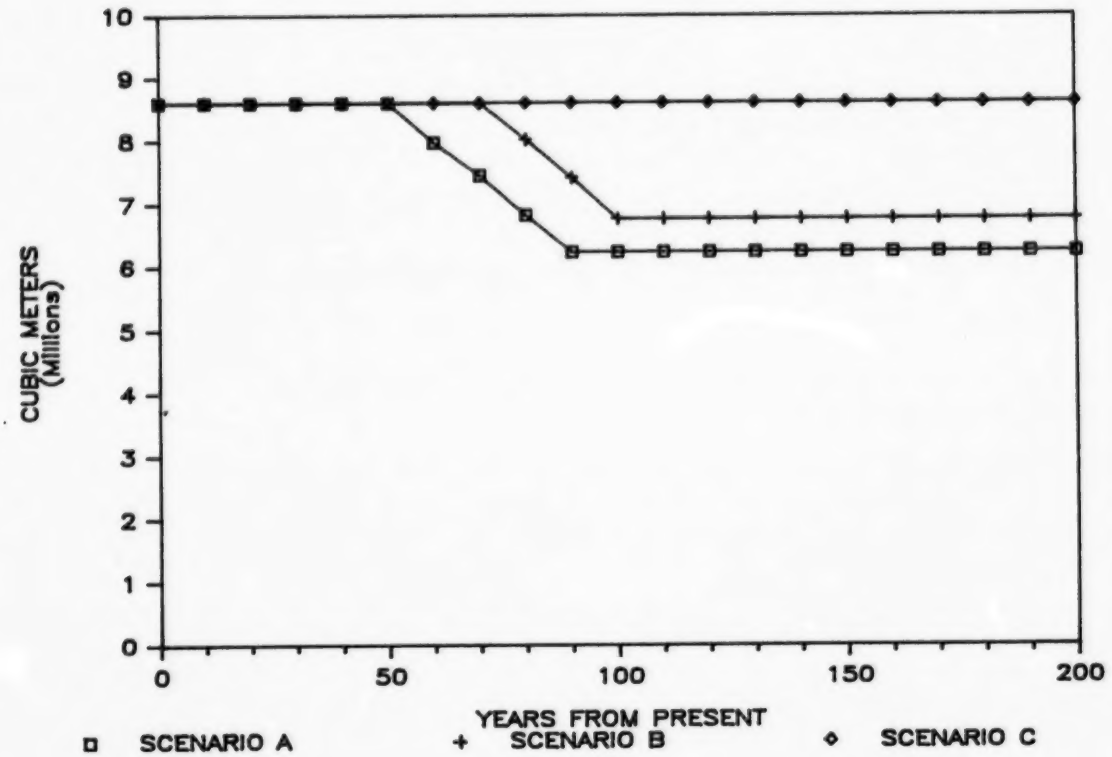


Figure 12. Harvest Forecasts for Scenarios B and C

When attempting to review the long-term merchantability of coniferous problem forest types for Scenario C, one is effectively trying to forecast improvements in both logging and milling technology as well as market trends for forest products. It is at best professional judgement based in part on past trends in these three areas.

In the attempt to look at what constitutes a problem forest type, as much as 100 years in the future, three other items must be addressed:

(1) With improvements in logging technology, more of the current ESAs could be harvested;

(2) Some of the existing NSR area will regenerate naturally to merchantable stands over the next 20 to 50 years or more; and

(3) Some of the existing "residual" stands will complete their conversion; that is, the existing immature understory will mature.

This long-term look-ahead for Scenario C results in the following additions to the Net Land Base:

- Coniferous problem types	660 400 ha
- ESAs	9 000 ha
- NSR (natural phase-in)	22 100 ha
- Residual conversion	2 900 ha
Total Additions	694 400 ha

The addition of 694 400 ha to Scenario B results in a total Net Land Base of 3 571 900 ha for Scenario C.

The timber supply objective of maintaining the AAC with the Scenario C Net Land Base and assumptions is presented in Figure 12. As shown, the current AAC can be maintained for at least 200 years. The LRSY of this scenario is 8 155 000 m^3 per year. This harvest level is not reached until 230 years.

At face value the results for Scenario C would suggest that utilization of problem forest types on a greatly increased scale would more than offset either the loss of the B.C. Rail Dease Lake Extension or any further decreases in intensive silviculture funding. The cautions here cannot be over emphasized. Utilization of problem forest types to the extent examined in Scenario C is still many decades and technological and market developments away. What the results do illustrate are first, the medium to long-term potential of problem forest types to address supply problems and second, the potential extent of "opportunity wood" represented by utilization of these types today. The impact that some "opportunity wood" stands have on increasing the rate of harvest is examined in Option III.

4.22 Increase Silviculture Program Funding

This scenario of Option II assesses the impact of increasing basic and intensive silviculture funding to address the falldown presented in Option I. The analysis assumptions which this alternative (Scenario D) is based on are as follows:

(1) Assume the B.C. Rail Dease Lake Extension is not operational, and therefore Supply Block A and B1 (Figure 5) remain excluded from the land base.

(2) Assume a 20 Year look-ahead period in reviewing problem forest types for inclusion, as per Option II, Scenario B.

(3) Assume that silviculture program funding will increase to the level projected in the fifth year of the 84/85 - 88/89 Five-Year Program. This level of funding will assume that basic silviculture will be achieved and a spacing and conifer release program will be implemented. The total cost of this program is $13,431,000 per year, and is presented in Table 4, in comparison to the program costs for the other scenarios presented in this report that examine no increases in the current allowable annual cut.

Table 4. Silviculture Program Assumptions

Treatment	Scenarios A, B, C			Scenarios D, E, F		
	Area (ha/yr)	Period of Treatment (years)	Cost[2] ($/yr)	Area (ha/yr)	Period of Treatment (years)	Cost[3] ($/yr)
Basic Silviculture:[1]						
- Site Prep. & Plant	17 300	200+	6,683,000	22 500	200+	8,790,000
- Site Prep. Only	6 800	200+	1,161,000	5 000	200+	845,000
- No treatment	10 400	200+	0	7 000	200+	0
Total Basic	34 500		7,844,000	34 500		9,635,000
Intensive Silviculture:						
- Backlog NSR, Site Prep. & Plant	5 500	14	2,316,000	5 500	14	2,316,000
- NCC, MSP & Plant	3 700	21	(4)	3 700	21	(4)
- Spacing	0	0	0	3 800	21	1,480,000
- Conifer Release	0	0	0	3 300	7	(5)
Total Intensive	9 200		2,316,000	16 300		3,796,000
Grand Totals	43 700		10,161,000	50 800		13,431,000

Notes:

(1) Cost of Basic Silviculture will vary by as much as 20% depending on the species profile harvested in any one year. With program dollars fixed it will be the treatable hectares that vary. The treated areas shown for basic are the average for the first two decades as derived from the Forest and Range Resource Analysis, 1984.

(2) Based on 84/85 program dollars (Status Quo Funding).

(3) Based on 88/89 projected program dollars (Fifth Year of Five-Year Program).

(4) Treated after completion of Backlog NSR restocking at a cost of $2,316,000 per year.

(5) Treated after completion of Spacing at a cost of $1,480,000 per year.

Since no Managed Stand Yield Tables (MSYTs) were available to predict yield gains from spacing and conifer release programs, yield gains from these programs were approximated by including more immature forest types than those allowed for in Option II, Scenario B. In this case, the gain in yield is attributable to the inclusion of more area rather than increases in MAI from changing yield tables. This approach resulted in an increase of 103 200 hectares bringing the Net Land Base total to 2 980 700 hectares (Appendix 7.1).

As shown in Figure 13, the length of time to the commencement of falldown is extended by 20 years to 90, before falling to the LRSY of 7 069 000 m^3 per year by 110 years.

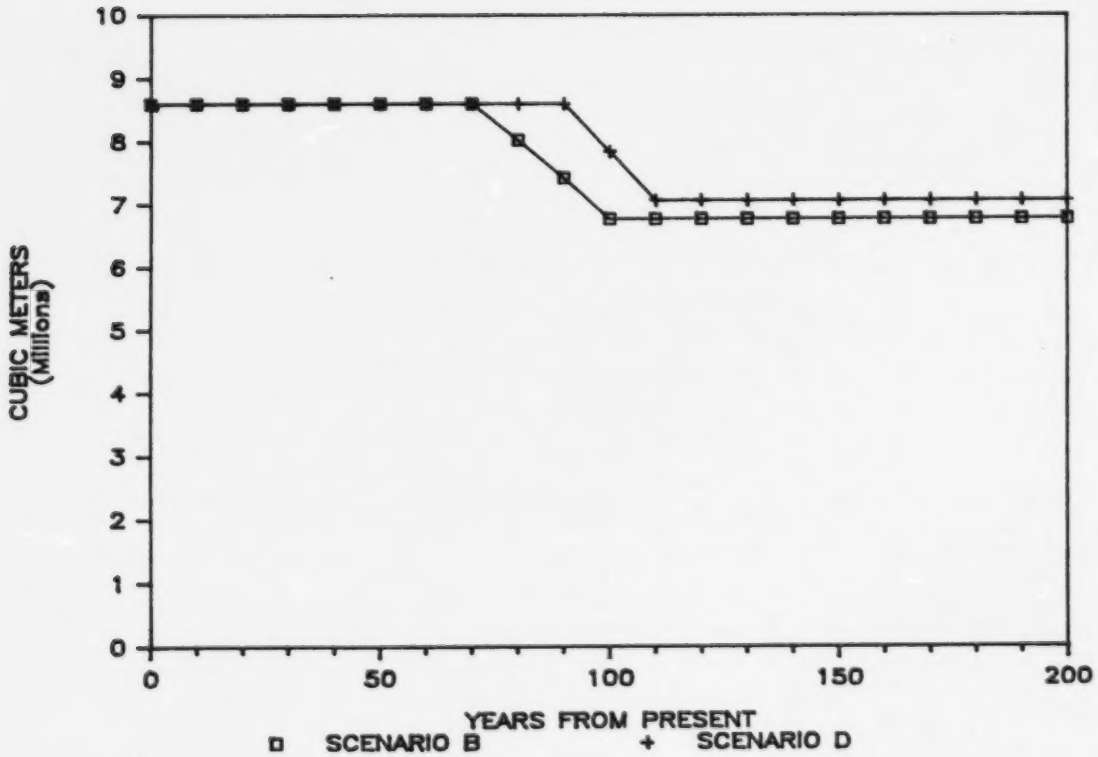


Figure 13. Harvest Forecast for Scenario D

Figure 14 presents the trends in total NSR and NCC area. As in Scenario B, 78 700 hectares of NCC lands are scheduled to be rehabilitated after completion of the backlog NSR reforestation starting during the second decade (i.e., in 14 years, Table 4), and therefore, Figure 14 projects an increase over the next 10 years. However in Scenario D, the NSR and NCC increases at a slower rate than that projected by the (84/85) level of basic silviculture funding since the (88/89) level of basic silviculture funding treats approximately 3 400 more hectares per year. Therefore, the rate of increase slows until the second decade. At that time the intensive silviculture funding is sufficient to treat the backlog NSR and NCC at a faster rate than it is being produced.

As illustrated, there is never complete elimination of the total NSR. As harvesting proceeds, there will always be a certain amount of land base out of production. Given the (84/85) level of funding the average Net Land Base out of production per year for Scenario B is approximately 173 000 hectares.

Given the improved (88/89) level of funding, the average Net Land Base out of production per year declines by approximately 36 000 hectares to 137 000 hectares.

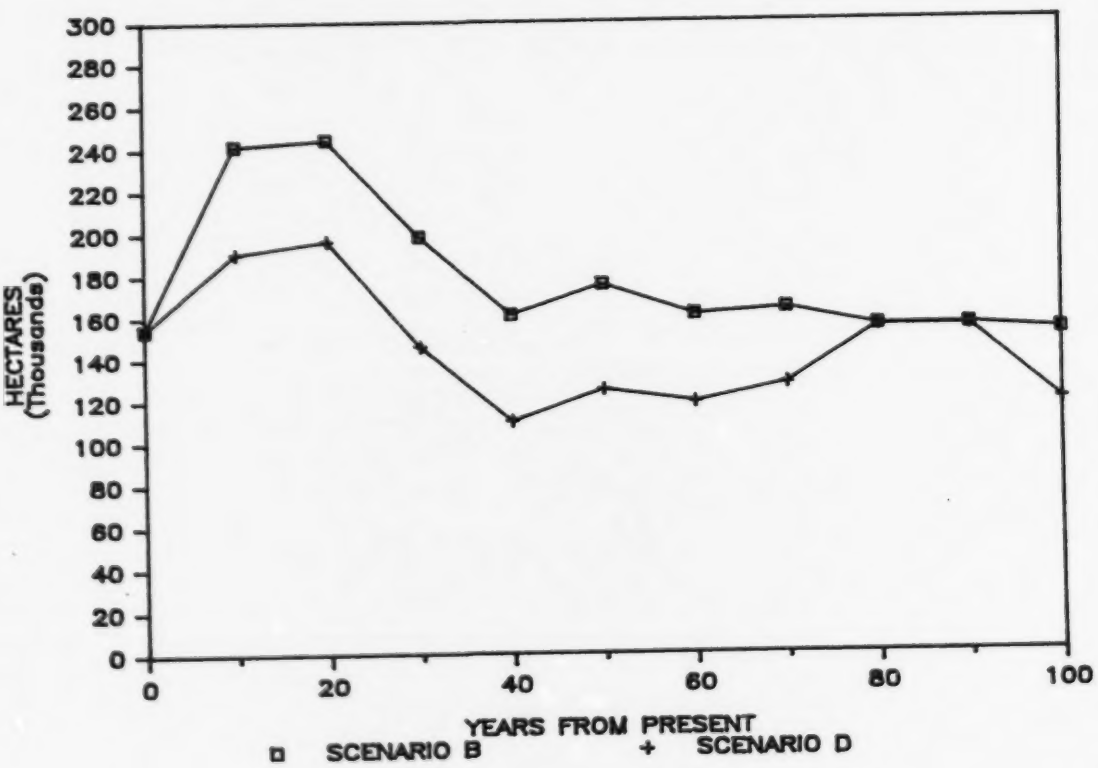


Figure 14. Forecasted Trends in NSR and NCC Area

4.23 Increase Protection Program Funding

This scenario of Option II assesses the impact of increasing protection funding levels to reduce unsalvaged losses to insects, disease, fire and windthrow. This alternative (Scenario E) expands on Scenario D and is based on the following additional assumptions:

(1) Assume that increases in protection funding levels immediately decreases unsalvaged losses.

(2) Assume that a total of $650,000 per year will decrease the bark beetle unsalvaged losses. Of this total, $400,000 per year is allocated for spruce bark beetle detection, monitoring and control. Additionally, $250,000 per year is allocated to detection, monitoring and control of the mountain pine bark beetle.

(3) Assume that fire losses will be minimized through improved detection, tanker base operations and Heli-attack capability at Bear Lake.

The net effect of these changes is to increase the protection program funding level to $959,000 from $309,000 and decrease the unsalvaged losses to 356 000 m^3 per year from 588 000 m^3 per year over the next 20 years. See Appendix 7.1 for a detailed summary of current and projected unsalvaged losses.

As illustrated in Figure 15, the effect of decreasing the unsalvaged losses is to increase the length of time until falldown by 10 years. Whereas in Scenario D, the falldown occurs after 90 years, in Scenario E, the falldown occurs after 100 years. The LRSY for this scenario has been increased by 111 000 m^3 to 7 180 000 m^3 per year. For purpose of comparison, Scenario D is also presented.

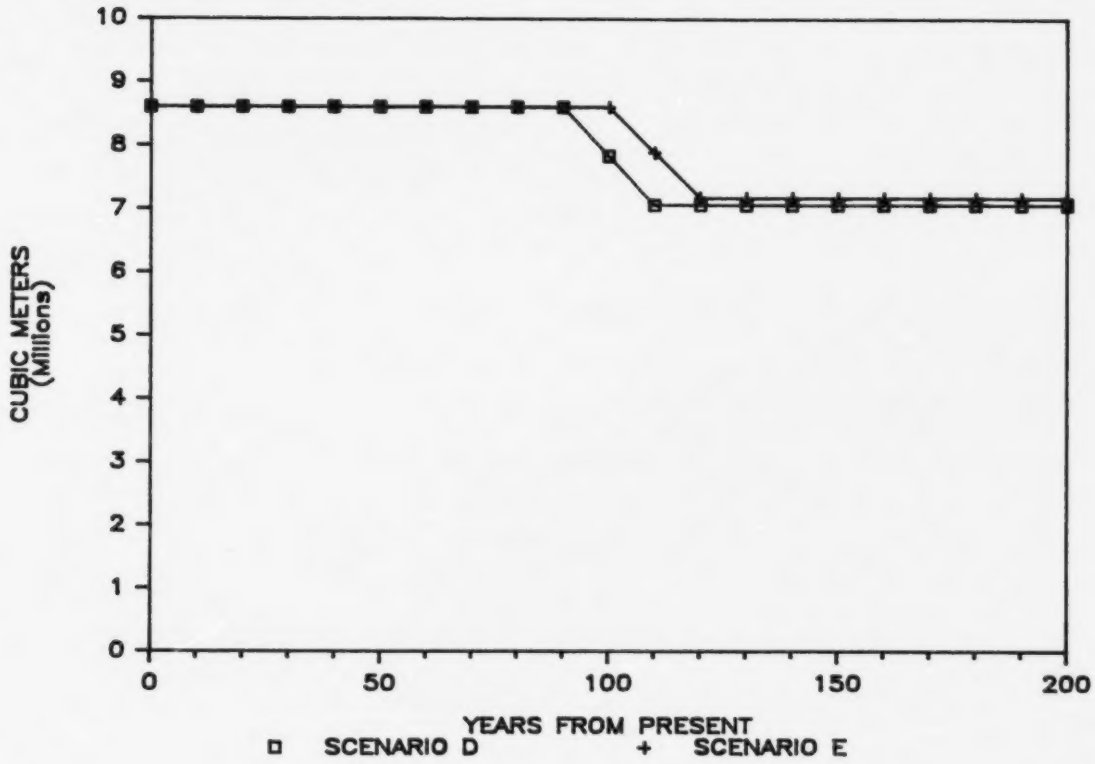


Figure 15. Harvest Forecast for Scenario E

4.24 Upgrade the B.C. Rail Dease Lake Extension

This scenario of Option II assesses the impact of harvesting and removing logs from the Sustut Supply Block and the North Takla Supply Block (Supply Blocks A and B-1 in Figure 5). The analysis assumptions in this alternative (Scenario F) expands on Scenario D to include the Net Land Base in the above supply blocks.

It is assumed that the only economic means of transporting logs from these supply blocks, is to haul to four loadouts situated on the B.C. Rail Dease Lake Extension and ship by rail car to Prince George. Presently the Dease Lake Extension is operational to Fort St. James, but due to deterioration of the road bed it is now unoperational past Fort St. James. The cost to restore the Dease Lake Extension to its former condition is not available at this time but it is estimated that the expense would be significant. However, if the Extension does become operational, approximately 207 200 hectares will become available, raising the Net Land Base to 3 187 900 ha from 2 980 700 ha.

As illustrated in Figure 16, the effect of assuming that the Dease Lake Extension becomes operational at any time in the planning horizon increases the length of time until falldown by 30 years. Whereas in Scenario D, the falldown occurs after 90 years, in Scenario F, the falldown occurs after 120 years. The LRSY of this scenario has increased by 431 000 m^3 from 7 069 000 m^3 to 7 500 000 m^3.

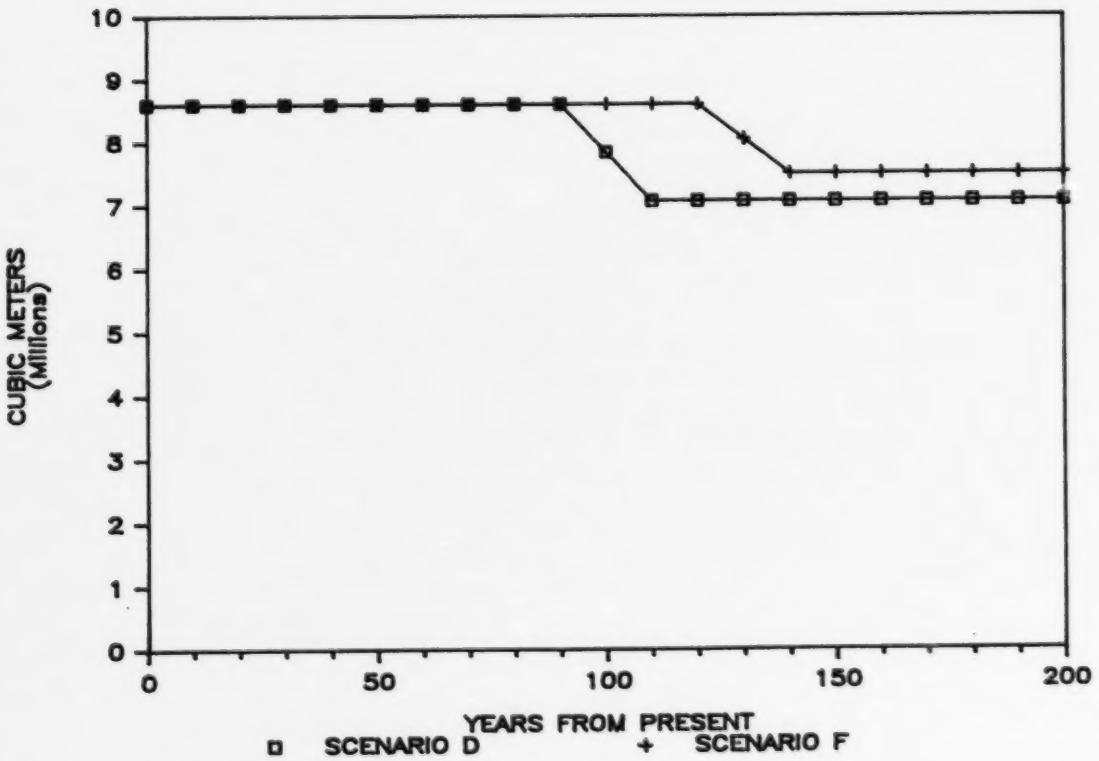


Figure 16. Harvest Forecast for Scenario F

Table 5 presents an overview of the scheduled harvest by Forest District as determined by the Prince George TSA 20 Year Operating Area Plan in comparison to the productive potential of each district to supply a sustained yield of timber (LRSY).

Table 5. Current Scheduled Harvest in Comparison to LRSY

Forest District	Scheduled Harvest (m^3 per year)	LRSY (m^3 per year)	% Falldown	Years Until Harvest=LRSY
Prince George East	2 683 000	1 805 000	33%	60
Prince George West	2 738 000	2 121 000	22%	90
Vanderhoof	1 404 000	1 236 000	12%	100
Fort St. James	1 780 000	2 313 000	0(1)	50
Total	8 605 000	7 475 000(2)	13%	130(3)

(1) Harvest rates in this District are 23% below the LRSY.

(2) Difference between this figure and LRSY reported for Figure 16 is considered negligible (.3%) and within the tolerances allowed in the analysis.

(3) Difference between this figure and that reported for Figure 16 is considered within the tolerances allowed in the analysis.

As illustrated above, the majority of Forest Districts in the Prince George TSA have more harvest scheduled in them than can be sustained. The Fort St. James Forest District, on the other hand, (which contains the Takla and Sustut Supply Blocks) is currently being undercut, and it is estimated that this could continue for up to 50 years unless earlier steps are taken to balance out the harvest with supply in all Districts. After 50 years and over the next 80 years, progressively more timber would be harvested in this District until the total TSA rate of harvest reached the LRSY (approximately 130 years from now).

4.3 Option III: Increase the Current Rate of Harvest

Option I forecasted the present and future timber supply assuming the continuation of current management practices, and Option II forecasted the present and future timber supply if changes are made to selected management practices and present harvest levels remain the same. This section assesses the benefits of realistic changes in management practices and examines the impact of increased annual harvest rates. The following opportunities exist to increase the AAC:

- improved utilization of coniferous forest types - Scenario G, Section 4.31;
- upgrading the B.C. Rail Dease Lake Extension - Scenario H, Section 4.32; and
- increased Protection 5 Year Program Funding - Scenario I, Section 4.33.

The timber supply objective in this option assumes that these management practices will increase the present AAC and additionally, the benefits from these practices will accrue to the harvest rate in the future by extending the period to falldown and/or by increasing the LRSY.

4.31 Improve Utilization of Coniferous Forest Types

Section 4.21 examined the extent to which changes in utilization of problem forest types will delay the time until harvest rates must gradually decline from their present levels. As marketing, harvesting, and milling technologies improve, it is expected that these forest types will contribute to the rate of harvest in future TSA Plan reviews. However, some interest has been expressed in capitalizing on this "opportunity wood" during the present TSA Plan review.

An opportunity to immediately increase present harvest levels exists through harvesting selected balsam problem forest types not included in the Prince George 20 Year Operating Area Plan. Some of these stands are currently accessible to Prince George but are of questionable merchantability. The additional areas examined for inclusion in the net land base are leading balsam stands in Supply Blocks E, G and H (Figure 4) not included in Scenario B, but included in Scenario C. Therefore this alternative (Scenario G) is based on all the assumptions of Scenario B, but with the inclusion of some additional balsam problem forest types.

The addition of these selected balsam forest types increases the Net Land Base by 83 600 hectares from 2 877 500 hectares to 2 961 100 hectares. Approximately 73% of these forest types are mature (Age Class 7 plus) with the majority of the stands, (57 000) in Age Class 8. Since most of these balsam stands are presently not being utilized, and if not harvested in the next 20 years may become economically non-harvestable due to volume losses by decay and disease, the rate of harvest could be increased. The dominant silviculture post-harvest prescription for these stands will be to rehabilitate a portion of these areas to spruce through site preparation and planting.

Since the marketing and manufacturing potential of utilizing these stands have not been demonstrated to date, the rate of harvest has only been increased by 150 000 m^3 for a 10 year period. The harvest policy of increasing the rate of harvest to 8 755 000 m^3 is depicted in Figure 17. For comparison, Scenario B is illustrated as well.

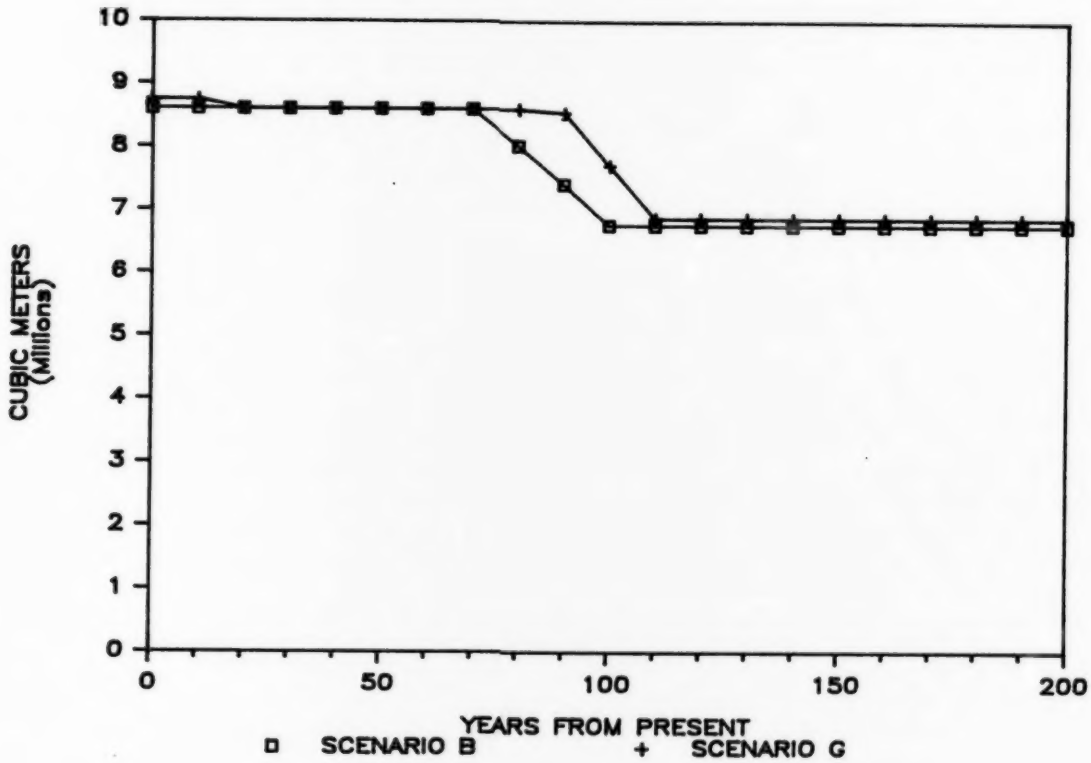


Figure 17. Harvest Forecast for Scenario G

As illustrated in Figure 17 the period to the commencement of the falldown was extended by 20 years to year 90, before falling to the LRSY of 6 890 000 m^3 per year. The increase of the LRSY by utilizing these balsam forest types and converting a portion of these stands to spruce is 122 000 m^3 per year.

Since the rate of harvest has increased by 150 000 m^3 per year, the rate of denudation will increase by approximately 700 hectares per year. It is conservatively estimated that to maintain basic silviculture on these areas through a regime of site treatment and planting, the required funding must be increased by approximately $219,000 per year. Therefore to maintain the same level of basic silviculture as that practiced in Scenario B (current 84/85 silviculture funding) on the TSA as a whole, the level of funding required would be $8,063,000 per year.

4.32 Upgrade the B.C. Rail Dease Lake Extension

Section 4.24 examined the extent to which the Net Land Base of Supply Blocks A and B-1 (Figure 5) will delay the time until harvest rates must be reduced from their present levels. It is expected in Scenario F that at some time in the future, the rail line will become operational and these areas will contribute to the rate of harvest in future TSA Plan Reviews.

During the TSA Planning Process it became apparent that the scheduled location of the current AAC over the next 20 years is contingent on restoration of the rail line. Three licensees have scheduled a portion of their licence commitments in the Sustut/Takla Supply Blocks. Table 6 indicates the concerned licensees, the loadout sites on the rail line, the available volume tributary to the rail line, and the scheduled operations from the Takla and Sustut Supply Blocks.

Table 6. Scheduled Operations in the Takla/Sustut Supply Blocks

Licensee	Loadout Site	Available Volume (m^3)	Scheduled Operations	
			Average Annual Harvest (m^3)	Year of Initial Harvest
Balfour Forest Products	Leo Creek	13 470 000	369 000	1987/88
Rustad Bros	Lovell Cove	10 370 000	94 000	1988/89
Northwood Pulp and Timber Ltd.	Driftwood	7 414 000	137 000	1989/90
Uncommitted	Suskeena	8 071 000	-	-
Total		39 325 000	600 000	1990

Preliminary discussions with B.C. Rail have indicated that the rail line may be fully restored by 1990, and could be operated without government subsidies, if 1.5 million m^3 per year of timber harvest can be scheduled along the extension. In order to accommodate this proposal, the rate of harvest for the TSA must be increased by 900 000 m^3 to supplement the 600 000 m^3 per year already scheduled by the above licensees. Scenario H in Figure 18 illustrates the effect on the present and future timber supply if the rate of harvest is increased to 9 505 000 m^3 per year. For comparison, Scenario F is illustrated as well.

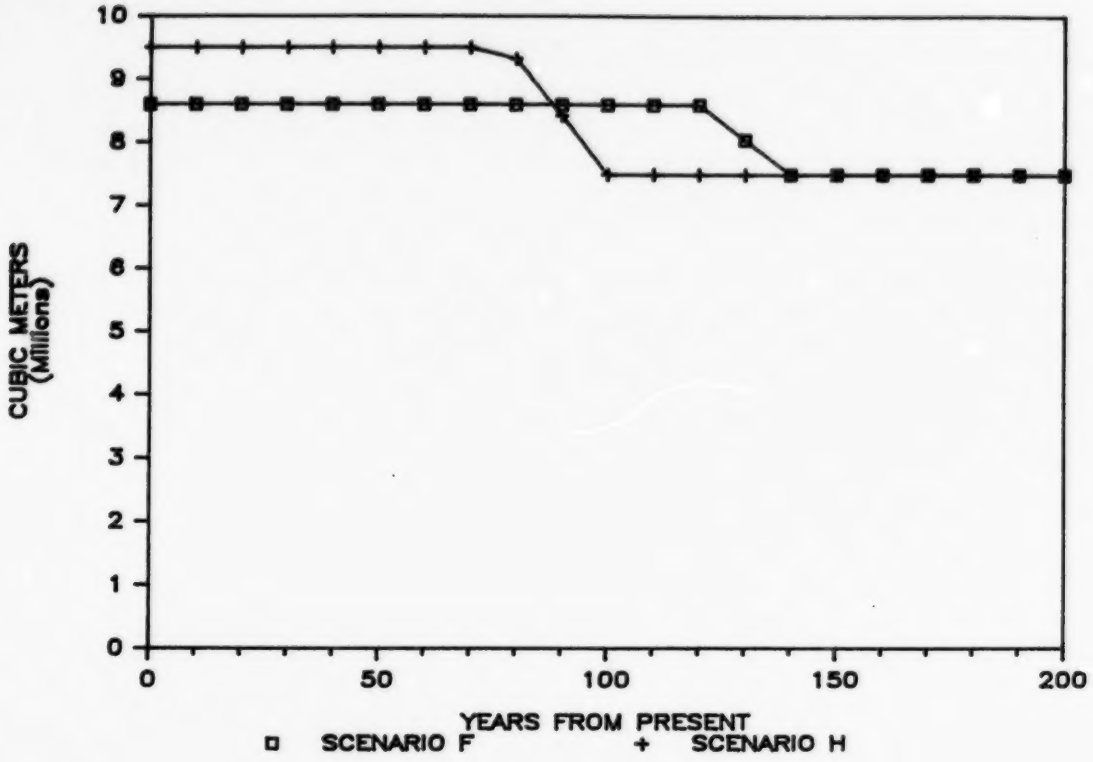


Figure 18. Harvest Forecast for Scenario H

As illustrated in Figure 18, an accelerated harvest of 9 505 000 m^3 can be maintained for 70 years before harvest rates fall to the LRSY of 7 500 000 m^3 by year 100. In comparison to Scenario F, increasing the rate of harvest results in a faster depletion of the inventory. The falldown occurs 50 years sooner and the LRSY is reached 40 years sooner.

Although Scenario H indicates that the increased rate of harvest may be maintained for 70 years, it is expected that the increase in the rate of harvest will only be a short term acceleration to ensure that the B.C. Rail services are restored. The majority of Forest Districts in this TSA have more harvest scheduled in them than can be sustained, and in the future, mature timber in the Prince George West and East and Vanderhoof Forest Districts will be a major limiting factor in the location of future harvesting activities. Therefore, the Takla and Sustut Supply Blocks and the Fort St. James Forest District will be relied upon to accommodate licensee demands in the future. For this reason, an extended acceleration of the harvest, of 900 000 m^3 would not be acceptable.

Since the rate of harvest in this scenario has increased by 900 000 m^3 per year, the rate of denudation will increase by 2 900 hectares per year. It is conservatively estimated, that the required funding must be increased by approximately $908,000 per year. Therefore, to maintain the same level of basic silviculture as that practiced in Scenario F (88/89 level of silviculture funding) on the TSA as a whole, the level of funding required will be $10,543,000 per year.

4.33 Increase Protection Program Funding

This scenario of Option III assesses the impact of an aggressive bark beetle control program which includes raising the current rate of harvest to salvage volumes which would otherwise become unsalvaged volume. This alternative (Scenario I) expands on Scenario D and E and is based on the following assumptions:

1) Assume the same protection funding levels as those assumed in Scenario E. Therefore a total of $959,000 per year will be spent on protection programs to decrease the level of unsalvaged losses to 356 000 m^3 per year from 588 000 m^3 per year over the next 20 years. In the long-term (80-200 years) this level of funding should reduce unsalvaged losses by an average of 111 000 m^3 per year.

2) Assume that increases in protection program funding levels immediately decreases unsalvaged losses and permits an immediate increase in the harvest rate. The additional volume harvested in Scenario E in comparison to Scenario D is approximately 25 900 000 m^3 over the length of the entire planning horizon (200 years). This gain translated into an annual increase in the harvest rate today, is approximately 130 000 m^3.

Therefore, for the purposes of this scenario, this harvest policy should allow for a 100 000 m^3 increase in the rate of harvest to allow for an aggressive salvage program. The current AAC apportionment (Table 2) allows for a Forest Service Reserve of only 77 880 m^3. This authorized volume has been traditionally used for salvage purposes, and since it has become a constraint on salvage efforts, this scenario illustrates the impact of the increased AAC in combination with an improved protection program. As illustrated in Figure 19, the effect of increasing the AAC by 100 000 m^3 and implementing an increased protection program to reduce unsalvaged losses will result in parallel harvest forecasts in comparison to Scenario D. The LRSY of this scenario is 7 169 000 m^3 per year.

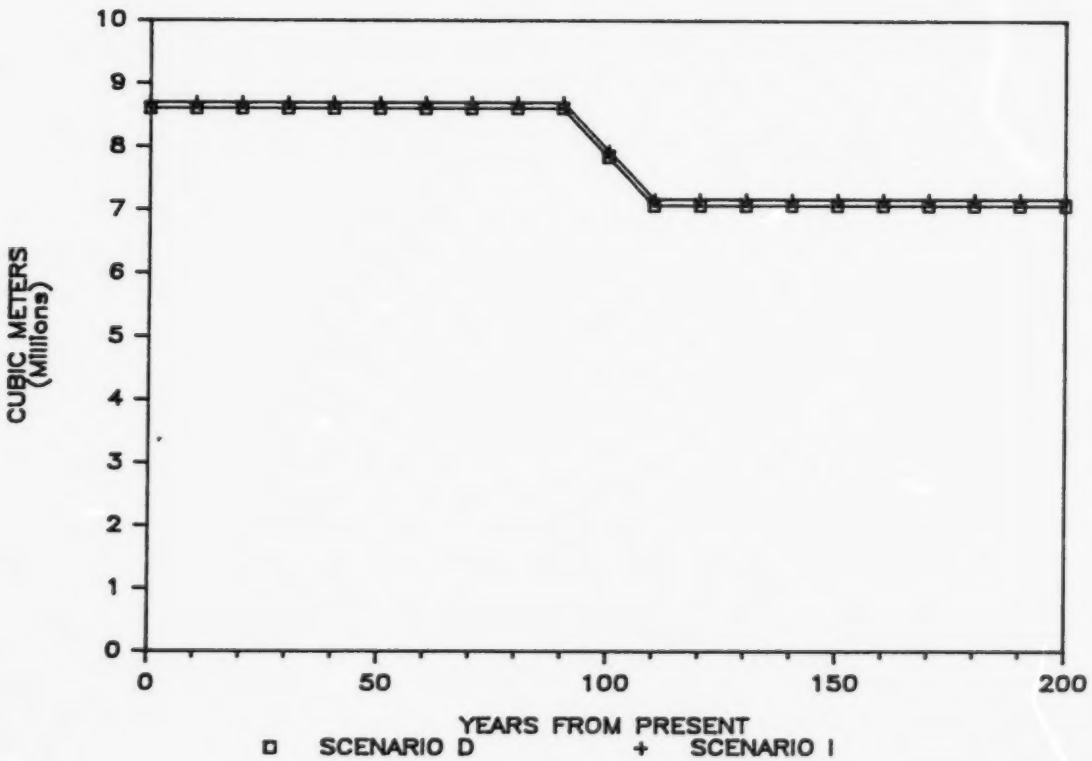


Figure 19. Harvest Forecast for Scenario I

5.0 SUMMARY AND COMPARISON OF OPTIONS

The analysis results for the options which are presented and discussed individually in Section 4.0 are summarized and compared in Table 7. Table 7 shows that:

- current harvest levels are maintained over the next decade for Options I and II, and increased for Option III. The minimum increase is 100 000 m^3 per year for Scenario I of Option III, and the maximum increase is 900 000 m^3 per year for Scenario H of Option III. If the combined management practices for all three scenarios of this option are implemented, then the total increase would be 1 150 000 m^3 per year;

- for all options examined, current harvest levels are subject to eventual falldowns. These falldowns range from a maximum of 2 368 000 m^3/year (28%) for Scenario A to a minimum of 450 000 m^3 per year (5%) for Scenario C;

- for all options examined, the quality of the forest industry's timber supply, as inferred through the physical harvest characteristics of average stand volume and diameter harvested declines slightly over the long term. The decline in stand volume harvested is about 25 m^3 per hectare from approximately 305 m^3 per hectare to 280 m^3 per hectare in all options. The decline in stand diameter harvested is about 6 cm from approximately 33 cm to 27 cm for all options;

- for all options the total area of NSR and NCC declines from a current high of approximately 8% of the Net Land Base to a long term average of approximately 5% of the Net Land Base;

- the only forestry programs for which costs have been quantified are the Silviculture and Forest Protection Programs. The options presented in this report are based on program levels which meet the current 5 Year Program goals or exceed them. That is for Option II, Scenarios D, E and F and Option III, Scenario G, H and I, implementation of a TSA Plan based on these scenarios would require substantial increases to current Five Year Program goals.

Table 7. Summary and Comparisons of Options

		Status Quo Option	Reduce Timber Supply Falldown Option					Increase the Current Rate of Harvest Option		
		A	B	C	D	E	F	G	H	I
Land Base and Inventory Characteristics										
Initial Net Land Base	(000's ha)	2 635	2 877	3 572	2 981	2 981	3 188	2 961	3 188	2 981
Final Net Land Base[1]	(000's ha)	2 490	2 719	3 377	2 817	2 817	3 013	2 798	3 013	2 817
Maximum Sustainable Yield (MSY)	(000's m^3)	6 584	8 001	9 588	8 212	8 212	8 687	8 172	8 687	8 212
Maximum Land Base Productivity	(m^3/ha/yr)	2.81	2.94	2.84	2.92	2.92	2.88	2.92	2.88	2.92
Required Forestry Programs[2]										
Basic Silviculture	(000's $/yr)	7 844	7 844	7 844	9 635	9 635	9 635	8 063	10 843	9 635
Intensive Silviculture	(000's $/yr)	2 316	2 316	2 316	3 796	3 796	3 796	2 316	3 796	3 796
Total Silviculture	(000's $/yr)	10 160	10 160	10 160	13 431	13 431	13 431	10 380	14 339	13 431
Forest Protection	(000's $/yr)	309	309	309	309	959	309	309	309	959
Harvesting Characteristics										
AAC	(000's m^3)	8 605	8 605	8 605	8 605	8 605	8 605	8 755	9 505	8 705
Average Short Term Yield[3]	(000's m^3)	8 605	8 605	8 605	8 605	8 605	8 605	8 680	9 505	8 705
Average Long Term Yield[4]	(000's m^3)	7 389	7 507	8 605	7 801	7 928	8 190	7 711	8 340	7 901
Long Run Sustained Yield (LRSY)	(000's m^3)	6 237	6 768	8 155	7 069	7 180	7 580	6 890	7 580	7 169
Average Area Harvested in Short Term[5]	(ha/yr)	30 200	30 200	30 400	30 100	29 400	30 400	30 900	33 300	30 100
Average Area Harvested in Long Term[5]	(ha/yr)	27 200	28 700	32 000	30 200	30 200	31 400	30 300	32 600	30 200
Average Stand Volume Harvested in Short Term[5]	(m^3/ha)	308	307	305	307	307	305	305	305	307
Average Stand Volume Harvested in Long Term[5]	(m^3/ha)	283	274	295	283	284	287	280	280	283
Average Stand Diameter Harvested in Short Term[5]	(cm)	33.2	33.2	34.0	33.2	33.4	33.6	33.1	33.2	33.2
Average Stand Diameter Harvested in Long Term[5]	(cm)	27.5	27.9	28.5	27.7	27.8	28.1	27.7	27.6	27.7
Forestry Characteristics										
Current NSR & DSD	(000's ha)	248	248	270	248	248	265	248	265	248
(% of Net Land Base)		(9)	(9)	(8)	(8)	(8)	(8)	(8)	(8)	(8)
Average NSR & DSD in Long Term	(000's ha)	162	173	203	137	136	140	182	145	137
(% of Net Land Base)		(6)	(6)	(6)	(5)	(5)	(5)	(6)	(5)	(5)
Unsalvaged Losses in:	(000's m^3)									
Years 1-20		588	588	588	588	356	588	588	588	356
Years 21-40		584	584	584	584	348	584	584	584	348
Years 41-60		460	460	460	460	268	460	460	460	268
Years 61-80		359	349	350	350	222	350	350	350	222
Years 81+		308	308	308	308	197	308	308	308	197

(1) Based on loss of 5.5% of area due to construction of logging roads and rights-of-way.

(2) Dollar figures reflect direct field costs only in 1984 dollars.

(3) Short Term is described as 0-20 years.

(4) Long Term is described as 0-200 years.

(5) Unsalvaged losses are <u>included</u> in calculation of these statistics.

6.0 DISCUSSION OF MANAGEMENT ISSUES

The initial direction and terms of reference for this timber supply analysis were given by the Statement of Issues, Options and Procedures (March 1984). That document identified a number of management issues which were considered, at that time, to be the issues of major concern to the Prince George TSA. A number of those issues, which included issues related to timber, range, recreation and other resource uses, were examined through the numerous preliminary studies (see references) and are addressed in the Prince George TSA 20 Year Operating Area Plan. Additional issues, primarily those related to timber management, are further addressed in this report. This section discusses the implications of the timber supply analyses of those issues.

1) The Overabundance of Mature Timber

The present inventory contains an overabundance of Age Class 8 timber (Figure 7 as an example) which presents a management problem, in terms of maintaining a sustained yield past 100 years. Harvest rates set at the LRSY may lead to unacceptable losses to beetle infestations, windthrow and a natural deterioration of these stands. All scenarios in this analysis are based on a harvest rate which equals or exceeds the present allowable annual cut, and to various degrees is well above the LRSY (see Table 7).

2) The Merchantability of Mature Age Classes

This analysis has assessed the merchantability of the existing forest profile by examining the yield implications of present merchantability practices, and those forecasted to improve over a 20 and 100 year time frame. Approximately 37% of the Productive Crown Forest Area is presently considered unmerchantable (problem forest types, deciduous types and low sites). As harvesting and manufacturing technology improves it is expected that only 19% of the Productive Crown Forest Area will be considered unmerchantable. Since the majority of these stands are mature and available for harvest, it is possible to increase the present annual allowable cut if it can be demonstrated that these stands will become economical to harvest.

3) The B.C. Rail Dease Lake Extension

The B.C. Rail Dease Lake Extension is required to enable existing licensee commitments to be maintained over the next 20 years. The Prince George TSA 20 Year Operating Area Plan assumes services will be fully restored by 1990. As other licensees begin to exhaust their mature timber supplies in the Prince George and Vanderhoof vicinities, the rail line will become even more crucial to support the TSA rate of harvest. This analysis has assessed the impact that the Takla/Sustut area has on the TSA rate of harvest and has also examined the implications of raising the TSA rate of harvest to ensure that rail car services are restored on the B.C. Rail Dease Lake Extension.

4) Improvement in Silviculture and Protection Program Funding

Increasing forestry programs are required to support present and future harvest rates. All scenarios in this analysis are based on a minimal level of basic and intensive silviculture and a minimal level of protection funding. Additional funding for these programs will decrease

the level of unsalvaged losses and improve the productivity of immature forest types. The extent to which these goals are achieved will be based on government funding. The measurement of goal achievement will be based on growth and yield improvements and future inventory updates. These factors (along with many other variables) all bear on the determination of the LRSY which is reviewed approximately every 5 years during the TSA planning process.

7.0 APPENDICES

7.1 Summary Tables

Table 8. Area Classification and Net Land Base Summary (thousands of hectares)

Classification	Gross Land Base	Net Land Base by Option and Scenario								
		I	II					III		
		A	B	C	D	E	F	G	H	I
Total TSA Area	7426.0									
Less: Non-Forest	1784.3									
Non-Crown	324.5									
Productive Crown Forest Area	5317.2									
Reductions to Productive Crown Forest Area										
Supply Blocks (A/B1)		607.5	607.5	607.5	607.5	607.5	0	607.5	0	607.5
Low Sites		99.0	99.0	99.0	99.0	99.0	177.3	99.0	177.3	99.0
Deciduous Types		284.6	284.6	284.6	284.6	284.6	297.3	284.6	297.3	284.6
NSR/OSD		68.6	68.6	46.5	68.6	68.6	70.3	68.6	70.3	68.6
NCC		0	0	0	0	0	0	0	0	0
ESAs		37.8	46.8	60.6	49.5	49.5	76.0	53.7	76.0	49.5
Unmerchantable Types		1584.8	1333.2	647.1	1227.3	1227.3	1508.4	1242.7	1508.4	1227.3
Total Reductions		2682.3	2439.7	1745.3	2336.5	2336.5	2129.3	2356.1	2129.3	2336.5
Net Land Base										
Immature	1762.2	763.1	814.1	1092.6	917.4	917.4	951.0	836.7	951.0	917.4
Mature	3208.1	1616.5	1808.1	2199.0	1808.1	1808.1	1964.9	1869.1	1964.9	1808.1
Residual	4.6	0	0	2.9	0	0	0	0	0	0
NSR/OSD	249.2	169.2	169.2	191.3	169.2	169.2	178.9	169.2	178.9	169.2
NCC	85.7	78.7	78.7	78.7	78.7	78.7	85.7	78.7	85.7	78.7
T.L. Reversions	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4	7.4
Total	5317.2	2634.9	2877.5	3571.9	2980.7	2980.7	3187.9	2961.1	3187.9	2980.7

Table 9. Protection Program: Unsalvaged Losses (thousands of cubic metres)

Scenarios:	A, B, C, D, F, G, H					E, I				
Period (Years):	1-20	21-40	41-60	61-80	81+	1-20	21-40	41-60	61-80	81+
Agent:										
Spruce Beetle	160.5	184.8	135.2	37.6	7.9	69.0[1]	80.1[1]	52.4[1]	16.7[1]	3.4[1]
Mtn. Pine Beetle	63.5	63.5	63.5	63.5	63.5	15.9[2]	15.9	15.9	15.9	15.9
Other Insect	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6	9.6
Fire	114.3	114.3	102.1[3]	89.9	77.7	102.9[4]	102.9	91.9	80.9	69.9
Windthrow:										
- Reserves	131.2	115.4	81.3	81.3	81.3	65.6[5]	57.7	40.7	40.7	40.7
- Fringe	40.9	36.0	25.4	25.4	25.4	25.4[5]	21.6	15.2	15.2	15.2
- Patch	68.8	60.5	42.6	42.6	42.6	68.8	60.5	42.6	42.6	42.6
Totals	588.8	584.1	459.7	349.9	308.0	356.3	348.3	268.3	221.6	197.3

1. Reduced losses to spruce beetle

	160.5	184.8	135.2	37.6	7.9	
- Improved funding*	-46.0	-53.5	-34.9	-11.2	-2.2	*(Cost estimated at $400,000/year for detection and monitoring).
- Improved response	-45.5	-51.2	-47.9	- 9.7	-2.3	
	69.0	80.1	52.4	16.7	3.4	

2. Reduced losses to Mountain pine beetle reflect 75% reduction. Cost estimated at $250,000/year for detection and monitoring.

3. Reduction in fire losses due to declining average volume/hectare for mature stands over time.

4. Estimated benefit of Bear Lake Heli-attack base and improved tanker base operation.

5. Reduced losses to windthrow reflect generally larger and better oriented cut blocks.

7.2 Analysis Methodology

The analysis methodology upon which this analysis is based is the collection of analytical procedures by which inventory descriptions, and timber supply forecasts are made for the options which are identified as part of the TSA planning process. This methodology consists of three major steps:

Data synthesis and aggregation:

Data synthesis and aggregation is the body of analytical procedures and systems software which transforms the information in the Timber Supply Analysis Data Package (Resource Planning Manual, Chapter 3, Section 3.9) into inputs for timber supply analyses. These procedures continue the aggregation and synthesis of inventory data, yield projections and local information, and prepare inputs which meet the format requirements of the forest planning model(s) to be used.

These procedures include:

- the reduction or "netting down" of the Total TSA area from a "gross" to a "net" land base;
- the integration of mature volumes and natural stand yield projections, and waste and breakage factors into yield curves for different utilization levels;
- the compiling of estimated program and treatment costs; and
- the formulation of management constraints, such as harvesting ages and priorities, into instructions for the forest planning model(s) to be used.

These procedures are carried out for each option which is designed. They include the associated procedures which provide for data summaries and reports as required. This analysis was carried out by Prince George Forest Region, Planning Section, using Industrial Forestry Services Ltd. software developed in consultation with the Resource Planning Section of the Planning and Inventory Branch.

Forest planning modelling:

Timber supply analyses are generally carried out using forest planning, inventory allocation and other models, which are based on simulation, linear programming and other analytical techniques. In this analysis, the simulation forest planning model IFSYIELD was used to generate the harvest forecasts and forestry reports which are presented. This model simulates a "prechosen" harvest schedule which reflects the timber supply objectives (Section 4.0), the data and management assumptions and constraints specified for each option, and the physical inventory at any given time in the planning horizon. The effect of unsalvaged losses is modelled by adding the losses to the assumed rate of harvest and then scaling down the resulting harvest forecast by that amount.

Interpretation of analysis results:

The analysis results provide bench mark calculations, suggested strategies or general insight into forest dynamics and harvest scheduling. Planning interpretations of these results are made through the preparation of this report.

Analysis and modelling methodology is subject to on-going change as new data, planning models, computer technology and other tools and procedures become available. An integral part of the "methodology" is to base an analysis on the most current methodology, and to monitor the effects of changes in methodology through a comparison of the "old" and "new" AAC Rationale Options as discussed in Section 7.3.

7.3 Uncertainty in Data Assumptions, Modelling Procedures and Analysis Results

This section examines the general question of uncertainty in the data assumptions and modelling procedures upon which the timber supply analysis results are based. In this way, this section attempts to assess the level of accuracy, or degree of confidence, that might reasonably be attached to the analysis results which are presented.

Such an assessment, however cursory or subjective, is a fundamental consideration in the interpretation and use of the analysis results. This includes the application of the analysis results to AAC determination and TSA plan development, and any influence that these results may exercise over other planning and management decisions.

The question of uncertainty is examined in three ways. Firstly, some bench mark comparisons are made. Secondly, sources of uncertainty are discussed. And thirdly, conclusions pertinent to the interpretation and use of the analysis results are drawn.

1) BENCH MARK COMPARISONS

A number of comparisons could be made as a step toward understanding, and possibly quantifying, uncertainty in timber supply analysis results. With the time and resources available, only the following comparison was made:

Comparison of the "1980" and "1985" AAC Rationale Options:

Chapter 1 of the Resource Planning Manual sets forth a framework in which plans are prepared. An explicit part of the framework is the monitoring of TSA plans and planning techniques. (Resource Planning Manual, Chapter 1, Page 34). This section discusses the AAC Rationale Option which compares the inventory and planning methodology used in this analysis and that used during the 1979 TSA Yield Analysis. The 1980 AAC Rationale formed the basis for the 1980 TSA AAC.

This comparison assesses the net effect of all inventory data, and inventory and planning methodology changes over the period 1979 to 1985, and evaluates the impact on the 1980 and 1985 AAC Rationale Net Land Base. Table 10 outlines the changes that have been made to inventory and planning methodologies. Table 11 presents a comparison of the AAC Rationale Option, in terms of the effect of these changes on the gross and net land bases. All management assumptions such as utilization standards, problem forest type deductions, etc. have remained constant.

Table 10: Comparison of the Inventory and Planning Methodology Changes

Methodology Changes	1979 Analysis	1985 Analysis
- Inventory		
- updates for depletion to	1978-1979	1983
- projections for growth to	1963-1976	1984
- updates for status to	1963-1976	1983
- Inventory methodology		
- site index curves and site classification	Ministry of Forests Site Index Average Volume Lines/PSYU Site Class VACs	Ministry of Forests Site Index Average Volume Lines/Zonal Chapman-Richards Site Class VACs
- Planning methodology		
- data synthesis and aggregation	As carried out in Yield Production Forecast Method	As carried out by IFS's Timber Supply Analysis System developed in consultation with Planning and Inventory Branch.
- Forest Planning Model	Timber RAM	IFSYIELD

Table 11: Comparison of the "1980" and "1985" AAC Rationale Option

Classification	AAC Rationale				% Change
	1980		1985		
Total TSA Area		7 747 500		7 425 500	- 4.2
Productive Crown Forest Area					
Immature	1 679 300		1 762 200		+ 4.9
Mature	3 393 300		3 208 100		- 5.5
Residual	10 100		4 600		-54.4
NSR & DSD	264 200		249 200		- 5.7
NCC	90 000		85 200		- 5.3
Subtotal	5 436 900	5 436 900	5 309 300	5 309 300	- 2.3
Reductions to Productive Forest Area					
Low sites	183 500		177 300		- 3.4
Deciduous types	262 100		297 300		+13.4
NSR & DSD	264 200		249 200		- 5.7
NCC	90 000		85 200		- 5.3
ESA	182 200		185 900		+ 2.0
Unmerchantable types	501 600		546 900		+ 9.0
Total Reductions	1 483 600	1 483 600	1 541 800	1 541 800	+ 3.9
Net Land Base					
Immature	1 358 600		1 341 200		- 1.3
Mature	2 594 700		2 426 300		- 6.5
	3 953 300	3 953 300	3 767 500	3 767 500	- 4.7
Maximum Sustained Yield (m^3/year)		8 707 600		9 441 800	+ 8.4
Maximum MAI (m^3/ha/year)		2.20		2.51	+14.0

Whereas Table 10 identifies the major differences in inventory assumptions, Table 11 shows the net effects of these differences on the Total TSA area, the Productive Crown Forest Area, the Net Land Base and the calculation of the Maximum Sustained Yield. The total TSA area has been reduced by approximately 4.2%, and the Net Land Base by 4.7%. The 1979 Analysis did not take into account TFL #42, the exclusion of the Morkill drainage to the McBride TSA and the exclusion of the Carp Supply Block to the Mackenzie TSA. As a result of harvesting and other deductions, the area of mature timber decreased by 5.5%. Subsequently, the area of immature timber increased by 4.9%.

In reviewing the reductions to the Productive Crown Forest Area, the area of NSR and NCC areas decreased by 5.7% and 5.3% respectively, while the area of deciduous forest types increased by 13.4%. Furthermore the area of Environmentally Sensitive Areas (ESAs) increased by 2.0% and those areas described as unmerchantable types increased by 9.0%.

The net result of these deductions applied to the Productive Crown Forest Area is a smaller area of mature forest (6.5%) and a smaller area of immature forest (1.3%).

Although the Net Land Base dropped by 4.7%, the Maximum Sustained Yield of the Net Land Base increased by 8.4%. Due to changes in growth and yield methodology, the direct result of these changes is a 14.0% increase in yield.

2) SOURCES OF UNCERTAINTY

Some of the sources of uncertainty which may be associated with the timber supply forecasts presented in this report are:

Provincial Forest Inventory:

The Provincial Forest Inventory is the basic data base upon which these timber supply forecasts are based. The overall statistical design of this inventory, where estimation of timber volume is concerned, is $\pm$ 10%, to a 95% confidence limit, at the PSYU level. In addition, a considerable amount of data processing occurs as part of the use of this inventory data in a timber supply analysis. The effects of this data processing on data uncertainty is difficult to quantify, but would have the general effect of increasing the above level of uncertainty.

Yield projections:

Yield projections, as distinct from estimates of current volumes, are another major information assumption upon which these timber supply forecasts are based. This includes empirical yield projections of existing and regenerated stands. In so far as yield projections represent a forecast of the future, rather than a measurement of current conditions, there is an inherent uncertainty associated with them. Although the nature and magnitude of this uncertainty can only be estimated subjectively, the body of literature on this subject and the 200 year planning horizon of the timber supply forecasts would suggest that $\pm$ 30% might be offered as a reasonable estimate of the uncertainties in projected yields.

Management assumptions:

In addition to inventory data and yield projections, these timber supply forecasts are based upon a host of management and policy objectives, constraints and other assumptions. At present, many of these factors are quantified subjectively on the basis of local knowledge and professional judgement. This includes, for example, estimates of operability, unsalvaged losses, regeneration delays and land use priorities. It must also be kept in mind that the timber supply forecasts are presented as decision tools (expected outcomes for assumptions made) rather than as predictions (the expectation that the forecasted outcomes will actually occur).

Modelling considerations:

Modelling considerations introduce a number of additional uncertainties into these timber supply forecasts. The discussion below considers these uncertainties to be of two kinds, one statistical in nature and the other a question of relevancy.

Mathematically, the output of an analytical model, such as the forest planning model IFSYIELD used here, will have a statistical uncertainty which stems from the statistical uncertainties, or errors, in its various inputs. For example, in the uncertainties in inventory data, yield projections and management assumptions as discussed above. It is beyond the scope of this report to attempt to quantify this kind of uncertainty. Suffice it to say that the effects on model output, of statistical uncertainties in model inputs are not simply additive but rather compound and interact in complex ways depending upon the structure of the particular model.

The other kind of uncertainty that derives from modelling is the question of relevancy. For example, a regression model may give a good statistical fit to a high quality data base but not address the resource management problem at hand. The question of relevancy, therefore, addresses the questions of externalities (factors which are not addressed in the model but which none-the-less bear on the problem) and model perspective or bias (the presentation of only one way of looking at the problem).

More specifically, an interpretation of the analysis results presented in this report should bear in mind:

- pest/forest dynamics:

  Based on the estimate of unsalvaged losses, mortality due to fire and insects appears to be a significant facet of forest dynamics in the Prince George TSA. These effects are not directly modelled by IFSYIELD. Based on recent model developments in this area, it is expected that the analysis results presented here underestimate the negative impact of spruce and pine bark beetle activities on timber supplies.

- management objectives:

  The over simplified management objectives which are assumed for these analyses provide poor resolution into the complex of short and long term socio-economic factors which bear on the AAC decision (Forest Act, Section 7) and TSA plan development.

- model resolution:

  The broad temporal and spatial resolution to which these analyses have been carried out average over a host of shorter term and more site-specific issues. For example, site-specific variability in treatment response. Such issues may be relevant, not so much to the AAC decision, but certainly to TSA plan development as it is intended to provide direction for program development.

3) CONCLUSIONS

The examination and discussion of uncertainty in this section is both cursory and subjective. It does, however, serve to emphasize the "soft" nature of the analysis results, and the need for improved resource data and analysis tools if improved decision-making support for TSA planning is to be provided in the future. This examination also serves to set forth some guidelines, and cautions, for the use of these analysis results.

For the purposes of interpreting the analysis results presented in this report, and applying them toward AAC determination and TSA plan development in the Prince George TSA, the following conclusions regarding the question of uncertainty are drawn:

- Qualitatively, the analysis results are biased toward a timber versus multi-resource, timber volume versus timber value, long term versus short term and forest level versus stand level perspective on the resource management issues in the Prince George TSA. In addition, this analysis is an analysis of the physical resource and only indirectly addresses socio-economic aspects of the forest resource.

- Quantitatively, it is the broad trends and comparative values, rather than the detailed numerical results, that are likely to have statistical significance in a decision-making sense.

- The uncertainty in "absolute" value of the harvest forecasts which are presented (i.e., uncertainty in prediction of actual outcome) is due primarily to the inherent uncertainties associated with the forest inventory and yield projections. Subjectively, and for lack of a better estimate, this uncertainty should be regarded as around $\pm$ 30%. This uncertainty, of course, also applies to the 1979 Prince George TSA analysis and to all similar timber supply analyses province wide. However, "current best estimates" (i.e. mean values) for inventory, yield projections and any other resource data assumptions are all that are ever available to the planner and are what, as a matter of standard practice, the planner bases his forecasts.

- the uncertainty in "relative" value of the harvest forecasts which are presented (i.e. uncertainty between harvest forecasts and hence between management assumptions) is considered to be much smaller (again, subjectively, around $\pm$ 10%). It is this greater sensitivity in uncertainty between harvest forecasts which is exploited in simulating the impact on timber supplies of changes in one or a few of the management assumptions which define the different options. And finally, since the purpose of the timber supply analysis and TSA planning process is to seek the best broad direction in forest management, there need be no reservations or delays, because of the question of uncertainty, in charting the course ahead.

7.4 Glossary

1) Allowable annual cut (AAC). The rate of timber harvest from a specified area of land. AACs are determined by the Chief Forest for Timber Supply Areas (TSAs) and Tree Farm Licences (TFLs) in accordance with Section 7 of the Forest Act, and for Certified Tree Farms in accordance with the Assessment Act. AACs are normally determined as part of a forest management plan (TSA Plan or TFL Management and Working Plan), and are subject to reassessment at least every five years.

2) AAC apportionment. The distribution of the AAC for a TSA among timber tenures by the Minister in accordance with Section 8 of the Forest Act.

3) AAC Rationale. The long term timber supply objectives and the broad management assumptions and strategies upon which an AAC is based. These include, for example, the harvest forecast, the net land base, timber harvesting priorities and constraints, timber utilization levels and standards, levels of unsalvaged losses and Five Year Program requirements and performances.

4) Alternative. See Option.

5) Analysis Unit. The basic building blocks around which inventory data and other information are assembled for use in forest planning models. Analysis Units represent the general level of aggregation, or detail at which a timber supply analysis is carried out. Analysis Units are normally defined as aggregations of inventory Type Groups and Site Classes, but may also be designed to incorporate considerations for geographic location or similarity of management regimes.

6) Available volumes. The portion of total inventory volumes which are available for harvesting after consideration for all management constraints on timber harvesting. These constraints are specific to an option, and include considerations for netting down, maturity, deferrals and any other priorities or constraints on timber harvesting.

7) Culmination age. The age at which a forest stand, for a stated diameter limit and utilization standard, achieves its maximum average rate of volume production. The age at which the mean annual increment (MAI) is a maximum.

8) Data assumptions. Analytical approximations and representations of the physical, biological and economic characteristics of the forest resource and its development over time. These include, for example, the forest inventory, yield projections, and reforestation costs.

9) Forest planning model. An analytical (usually computer based) model which successively harvests and grows collections of forest stands over a period of several decades according to specific data and management assumptions. Forest planning models are of two basic forms -- forest estate simulation models, which address "what-if" questions by simulating a specified policy or management alternative, and linear programming harvest scheduling models, which seek out the policy or management alternative which optimizes the attainment of a specified management objective subject to specified management constraints.

10) Harvest forecast. A measure of timber supply. A harvest forecast is usually a measure of the maximum timber supply that can be realized, over time, from a land base for specified management assumptions. It is an output of forest planning models and is a function of the size and productivity of the land base, the current growing stock, the length of the planning horizon and the totality of management objectives, constraints and assumptions and how they are modelled.

11) IFSYIELD. A forest estate simulation model developed by Industrial Forestry Services (IFS). This model addresses "what if" questions by simulating a specified policy or management alternative.

12) Linear programming. An Operations Research technique which has been drawn upon to provide the mathematical optimization procedure in forest planning models such as Timber Resource Allocation Method (Timber RAM), Multiple Use Sustained Yield Calculation (MUSYC) and FORPLAN.

13) Long run sustainable yield (LRSY). A measure of land base productivity for specified management assumptions. LRSY is determined as the long term sustainable level (asymptotic value) of the harvest forecast generated by a forest planning model. LRSY is a function of the size and productivity of the land base, the current growing stock, the length of the planning horizon and the totality of management assumptions (for example, unsalvaged losses, regeneration delays, managed stand yield tables, extended minimum cutting ages, etc.) and how they are modelled . Roughly speaking, LRSY can be thought of as the Maximum Sustained Yield (MSY) of a land base, adjusted upwards or downwards by the imposition of management objectives and constraints on the land base.

14) Long term. The period covering more than one rotation (normally, 0-200 years).

15) Management assumptions. Analytical approximations and representations of management objectives, priorities, constraints and other conditions. These include, for example, the criteria for netting down the land base, the specification of minimum cutting ages, utilization levels and standards, cut/leave ratios and the assumed silviculture and pest management programs.

16) Management issues. Known or anticipated problems and perceived opportunities which surround the management of timber, range, recreation and other resource values.

17) Management strategy. A game plan. In the TSA plan, the policies, priorities, and actions, and how these are orchestrated, to implement the management direction (i.e., production targets) established in the current plan.

18) Maximum Sustained Yield (MSY). A measure of land base productivity. The MSY for a land base is the sum of the product of the maximum MAI, based on empirical yield projections to specified diameter limits and utilization standards, and the land area for each major timber type.

19) Mean annual increment (MAI). Stand volume divided by stand age. The stand age at which the MAI assumes its maximum value is called the culmination age.

20) Model. An abstraction and simplification of reality which is constructed to aid the understanding of an actual system or problem at hand. Forest managers and planners have made extensive use of this concept for a long time. For example, maps, classification systems and yield projections are all models.

21) Net Land Base. The portion of the total land area of a management unit which is considered to contribute to, and be available for, long term timber supply. The net land base is defined for an option by reducing (or "netting down") the total (or "gross") land base in a manner consistent with the management assumptions for that option.

22) Option. A set of assumptions representing a possible management direction. Options are constructed as a normal part of a planning process in order to provide a framework for analysis and facilitate management decision-making. The term option can be used in the context of a management option, a planning option or an analysis option depending upon the nature of the assumptions defining the option. An option is usually synonymous with an "alternative" or "scenario". However, an analysis of an option may take the form of a number of different model scenarios or "runs", each representing minor changes within a broad set of assumptions.

23) Planning horizon. The time frame addressed in a plan or in analyses carried out in support of a plan. A planning horizon includes a "look-ahead" period which is required to understand resource dynamics and provide a basis for evaluating alternatives, and a "detailed" period which is needed to lay out management guidelines and provide a basis for operational decision making.

24) Production target. A forecast of resource supply over time, based on current policies, programs and practices, and their continuation over the planning horizon. In the TSA plan, production targets are identified for timber harvesting, forage harvesting and recreation opportunity. The first five years of the timber harvesting production target is the AAC for the TSA for the term of the current TSA plan.

25) Regeneration delay. The number of years between the denudation of a forest stand by harvesting or natural causes and the establishment (germination) of the next crop. The point at which the next crop is regarded as established must be consistent with the origin of the yield projection which will be assumed to describe the yield development of the next crop.

26) Regulated forest. A forest with a distribution of age, size and productivity classes such that an approximately equal annual or periodic yield may be harvested in perpetuity. The regulated, or "normal", forest is a useful concept but is seldom realized in practice.

27) Rotation age. The number of years, following denudation, required to establish and grow a timber crop to a specified condition of maturity. The rotation, or cutting age is often chosen as the culmination age.

28) Scenario. See option.

29) Site index. A measure of site productivity. Site indices are based on tree height as a function of stand age and usually expressed graphically as site index curves. A number of site index curves have been developed for British Columbia's major commercial tree species. For example, standard MoF (all species), Goudie (lodgepole pine and interior spruce), Bruce and King (coastal Douglas-fir), etc.

30) Short term. The period covering the next 20 years.

31) Timber supply analysis. The assessment of future timber supplies over long planning horizons (typically 0-200 years). Timber supply analyses are carried out using forest planning models for the different options identified in the TSA (or TFL) planning process.

32) Timber Supply Area (TSA). An integrated resource management unit established, in accordance with Section 6 of the Forest Act, as a revision to and a consolidation of the former Public Sustained Yield Units. The TSA is the land unit with respect to which TSA planning is carried out.

33) TSA plan. The forest management plan developed for a TSA. The TSA Plan establishes the long term supply objectives and the broad management strategies for the timber, range and recreation resources in the TSA. For the timber resource, the TSA plan establishes an AAC and 20-year licensee operating areas.

34) TSA planning process. Forest management planning as carried out for TSAs in accordance with Chapter 3 of the Resource Planning Manual.

35) Timber supply forecast. See harvest forecast.

36) Twenty-year supplies of Crown timber. Designation for planning purposes, of the geographical location of the supply of Crown timber over the 20-year planning horizon of the TSA plan. Such areas are shown on a map accompanying a TSA plan document. Because the location of the timber harvest is the major determinant of access development, crop renewal, crop protection and crop enhancement Five Year Program requirements, and expected integrated resource use conflicts, its designation is an essential component of a TSA plan. Because of changing conditions and the MoF's volume based tenure system, these designations are subject to review along with the TSA plan. These designations may be largely a matter of licensee preference, or their determination may be crux of the development of a TSA plan. Normally, these designations conform to or are developed from "planning areas", "interest areas", "chart areas", "operating areas" or other such formal or informal designations.

37) Unsalvaged losses. The volume of timber killed (annually over a specified Net Land Base) by natural causes and not harvested. Unsalvaged losses include the volume of timber actually killed plus any residual stand volumes rendered unmerchantable. Sometimes called Non-recoverable Losses.

38) Yield projections. Forecasts of future yields from forest stands or timber types. Yield projections can be developed for stand volume, stand diameter or specific products, and for empirical (averagely stocked), normal (optimally stocked) or managed stands. Yield projections can be based on a number of mensurational approaches and procedures including the use of site index curves (see site index) and generalized growth models (for example, Chapman-Richards, Ek/Payandeh, etc.).

7.5 References

1) AAC Rationale Report, Ministry of Forests, Planning and Inventory Branch, Resource Planning Section, pp 83-86.

2) Resource Planning Manual, Chapters 1, 3 and 8, Ministry of Forests, Planning and Inventory Branch, Resource Planning Section.

3) Statement of Issues, Options and Procedures, March 1984, Ministry of Forests, Prince George Forest Region.

4) Prince George TSA Data Package, August 1984, Ministry of Forests, Prince George Forest Region.

Preliminary Studies:

5) Prince George TSA Supply/Demand Analysis, Ministry of Forests, Prince George Forest Region.

6) Technical Paper Describing Problems Associated with Harvesting Sensitive Slopes in the Prince George Forest Region, Ministry of Forests, Regional Ecology, Prince George Forest Region.

7) Operability Overview of Supply Blocks E, G and H, Prince George TSA, Ministry of Forests, Regional Planning, Prince George Forest Region.

8) The Sustut Block, Access Development Study, Ministry of Forests, Engineering Branch, Victoria.

9) Review of the Cedar and Hemlock Utilization Problem, Prince George TSA, Ministry of Forests, Regional Planning and Timber, Prince George Forest Region.

10) Estimating Timber Availability using Multiresource Cut/Leave Ratios, Ministry of Forests, Regional Planning, Prince George Forest Region.

11) Information Package to Assist in the Identification of Candidate Areas for Intensive Silviculture, Ministry of Forests, Regional Planning, Prince George Forest Region.